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NWS EARLE
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION II
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, NEW YORK 10278

11 Aug '92

11 AUG 1992

Gerald F. Hoover
Naval Facilities Engineering Command
10 Industrial Highway
Code 1821, Mail Stop 82
Lester, PA 19113-2090

Re: NWS Earle Draft RI Report

Dear Mr. Hoover:

The U.S. Environmental Protection Agency (EPA) has reviewed the RI Report (§1-5), dated March 1992 and (§6-8), dated May 1, 1992. Enclosed are comments to §1-5, Attachment 1 consists of Versar's comments, while Attachment 2 consists of partial comments from EPA. The rest of the comments to §1-5, and those for §6-8 will be transmitted to you next week.

After the U.S. Navy has had an opportunity to review and respond to these comments, a meeting will be held to discuss them.

If you have any questions concerning this matter, please contact me at 212-264-6609.

Sincerely yours,

Paul G. Ingrisano

Paul G. Ingrisano
Project Manager
Federal Facilities Section

Enclosure

cc: CPT W. M. Migrala, Jr., NWS Earle
~~LCDR J. P. Dell, NWS Earle~~
J. Freudenberg, DEPE
R. Johnson, Weston

Vertani's Comments

1.0 Introduction

1. This letter report has been prepared to provide review comments relative to the Phase III Remedial Investigation Report for the Naval Weapons Station (N.W.S.) Earle in Colts Neck, New Jersey. The document is being submitted to the USEPA, Region II by the PRP contractor as Volume I (Technical Data) of the Draft Interim Report for the 11 sites investigated in this study.

2. Section I of the document indicates that baseline risk assessment data, ARAR development and a screening of remedial alternatives will be added to the report at a later date. Due to the data gaps indicated in the report comments, which follow this introduction, there is some doubt that a complete baseline risk assessment can be satisfactorily prepared at this time. The screening of remedial alternatives is also dependent, in part, on completion of the baseline risk assessment; therefore, it is critical to address these data gaps at the earliest possible time.

3. Most of the data deficiencies addressed herein concern the lack of sufficient data for use in defining the extent of contamination at various sites. However, the methods through which analytical data is presented and interpreted in the report also contribute to the difficulties encountered in assessing the degree of impacts to various site media.

4. In order to expedite the progress of CERCLA activities at the N.W.S. site in accordance with mileposts in the Federal Facility Agreement, it is recommended that a prioritization scheme be developed for addressing those data gaps which are believed to be most critical. In this manner, a response strategy plan could be developed to avoid long delays in the implementation of remedial actions, where these may be needed most.

1.1 General Comments

1. The RI Report is missing several of the key components of a remedial investigation recommended in Guidance for Conducting RI/FS Under CERCLA. Specifically, the report does not clearly define the extent of contaminant plumes, and does not adequately evaluate potential migration pathways.

2. The report provides multiple tables of analytical data but lacks any detailed discussion relative to the interpretation of this data.

3. Comparison of data to "background" conditions at a number of sites is questionable, because a sampling point that is considered upgradient from one well or boring may be downgradient from another site. A true comparison of site-related contaminants to background conditions should allow a comparison to an area which has not been impacted by any site-related activities.

4. The report makes several references to a "normal background range" for metals found within soils, however, no reference is made to the fact that some of the metals concentrations are in excess of NJDEPE guidelines. For example, several soil samples taken from Site 2 exceed NJDEPE cleanup guidelines for chromium, but no reference to these guidelines is made in Section 4.1.2.1 (page 4-6) of the report.

5. All data summary tables should be clearly labeled. For example, Table 4-3b present three types of information within each column, but there is no explanation as to what these different numbers represent.

1.2 Strategy in Conducting the Remedial Investigation

1. The segmentation of the Remedial Investigation at Naval Weapons Station Earle (N.W.S.) precludes the presentation of a holistic perspective of contaminant distribution trends. A grouping of contiguous sites into common operable units may present an entirely different interpretation of extent of contamination than when viewed separately. For example, the wells at site 2 lie downgradient of site 5 and are presumably in the same aquifer. Chromium and lead concentrations are present in ground water samples at both sites but there is no discussion of the possible interrelationship of these plumes.

2. Partly because of this a la carte study of individual sites, no graphical presentations of contaminant trends are made on the site as a whole. Each report section discusses contaminant levels and causative factors at a given site but no definition of actual plume geometries is provided. In this respect, the document falls short on meeting one of the primary objectives of the Phase III study which is to determine the extent of contamination. The lack of detail on contaminant distribution in various site media weaken the basis for performing a baseline risk assessment.

1.3 Hydrogeologic Characterization

1. Water table maps are presented for 11 sites described as occurring in at least 5 distinct formations. No reference is made to which lithologic units

in any of these formations constitutes an aquifer per se at each site. Aside from the generic description of the regional hydrostratigraphic framework in the beginning of the report, site specific aquifer relationships are not evaluated.

2. The "composite" water ground water table map presented in Figure 2-1 represents water table elevations not in a single aquifer, but in multiple aquifers. Interpretation of contaminant transport patterns on a site-wide basis is difficult, if not impossible, when a knowledge of ground water flowpaths in the aquifer system have not been established.

3. An example of this is sites 2, 5 and 11. The water table for each of these sites is described as occurring in the Vincentown formation. All are located within the outcrop belt of the Vincentown formation and are characterized as areas of recharge to aquifers in this formation, yet hydraulic gradients in this area decrease in a northerly, or updip direction. If static water levels in wells downdip in the Vincentown (just north of the ground water divide at N.W.S.) are higher than those observed in wells in the outcrop area, then the latter is not an area of regional recharge. This being the case, interformational leakage from the overlying Kirkwood formation recharges the Vincentown aquifers in the area north of the divide (see also page 2-13, paragraph 2 of the RI document).

4. The ramifications of this are that contaminants entering the Kirkwood formation and associated aquifer(s) may be transported from sites such as 10 and 22 into the underlying Vincentown formation. In the absence of any data relative to vertical gradients and ground water movement, or water quality data from intermediate and deep aquifer segments, such transport pathways cannot be evaluated. This same concern applies to other formational contacts like the Hornerstown/Kirkwood. References in the report to rapid infiltration, areas of recharge and well screens gone dry all suggest that interpretation of vertical components of ground water flow may be critical to an accurate assessment of contaminant transport at N.W.S.

5. No basis exists upon which correlations between water quality parameters in surface and ground water samples can be made. Examples of sites where surface water and ground water relationships have not been established include sites 4, 10 and 19.

1.4 Data Quality[1]

1. Site piezometric data appears to be generally acceptable, with the exception of some minor concerns about well development. Well development of very limited duration in some wells may not assure total communication between well screen intervals and the aquifer. There are also instances where proper allowance was not given for significant water table fluctuations resulting in well screens going completely dry. The placement of well screens at slightly greater depths may have avoided this problem and its effects on the acquisition of piezometric and water quality data.

2. The placement of well screens at water table depths very near to the ground surface also introduces another problem: bentonite seals (some only 0.5 feet in total thickness according to the report appendices) placed immediately below grade are often disturbed and sometimes breached during the installation of the outer protective casings under these conditions. Analytical data quality may be jeopardized in wells such as these. Infiltration of surface water along the well annulus could produce false positive or negatives and not be reflective of contaminant transport from the source areas of concern.

3. Site boring and well logs indicate a broad range of soil types at N.W.S., thus the range of hydraulic conductivities might be expected to reflect this variability. However, of 22 slug tests conducted, all reported hydraulic conductivities were within the same order of magnitude (i.e. 0.5 to 5 feet per day) except those for MW2-1 and MW2-5. A variety of filter packs were installed (some as mixtures of more than one gradation) which may have affected rising head measurements. The performance of one or more pump tests at strategic locations on the site may have generated hydraulic conductivity data both for larger aquifer volumes and lithologic variations between Cretaceous and Tertiary formations. Such data would enhance ground water velocity calculations used in contaminant transport interpretations.

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[1] Applies to data quality concerns associated with several types of well construction techniques employed over time in developing the current complement of site monitoring wells. Comparability of analytical (chemical) data from wells of varying construction is a quality control issue which warrants some discussion in the final RI report.

1.5 Specific Comments

1. Page 1-5/Paragraph 2:

   - Stated objective to quantify extent of contamination has not been met.

2. Page 2-14.Paragraph 2:

   - The meaning of the terms residential and municipal wells is unclear. Are these terms meant to distinguish between private and public well supplies? If so, are the extensive residential wells nearby the site possible receptors? A plate indicating water supply wells contiguous to N.W.S. would present a more reliable basis for risk assessment purposes.

3. Page 2-14/Paragraph 3:

   - Information on exact location and details of construction of supply wells should be provided. This data could have some bearing on contaminant transport in sites contiguous to the well's capture zone and the potential for cross contamination via the well's annular space.

4. Page 3-20/Paragraph 4:

   - Reference is made to a silt/clay used as the limiting factor in determining well screen depths. Three wells in the site 3 area are later reported (page 3-22/paragraph 2) to have gone dry between sampling rounds which suggests leakage may occur through this silt unit and deeper sampling intervals may be warranted.

5. Page 3-34/Paragraph 2:

   - The Phase II study determined (horizontal components of) ground water flow for the site.

6. Page 3-40/Paragraph 3:

   - Ground water flow directions are poorly defined due to the limited head differentials and the positioning of site wells.

7. Page 4-3/Paragraph 3:

   - The calculated ground water velocities span two orders of magnitude thus do not facilitate contaminant transport estimation for comparison with actual water quality data observed in downgradient site wells.

8. Page 4-4/Figure 4-1:

- MW2-1 is the upgradient (background water quality) well for site 2 but is also downgradient of the landfill at site 5. Background water quality at site 2 is therefore questionable.

9. Page 4-13/Paragraph 4:

- There appears to be some inconsistencies in the use of the term "normal background" levels. This paragraph states that levels of metals appear to be within normal background ranges, but on page 3-14 the report argues that metals in ground water are attributable to soil conditions that have been broadly impacted by human activities. Conditions that have been broadly impacted by human activities are not naturally occurring.

10. Page 4-16/Paragraph 1:

- Surface water and ground water interrelationships are unknown thus impacts observed in ground water samples cannot be used to determine any stream sampling requirements.

11. Page 4-16/Paragraph 3:

- Ground water level may have dropped more rapidly at this site than at others due to recharge to the lower portions of the aquifer. Water quality assessment at deeper aquifer segments at this site is probably warranted.

12. Figure 4-2:

- Lithologies from the seven boring logs used in the preparation of the cross section have not been posted for each well. Correlations cannot therefore be evaluated and the interpretation presented (i.e. a thin near surface aquifer underlain by a confining unit) cannot be verified. Hydraulic properties of the confining, if present, would provide better justification for limiting the depth of well screen placement at this site.

13. Page 4-19/Figure 4-3

- The water level for MW3-7 of 115.2, should be on the north side of equipotential contour line of 114 feet not south as in indicated in figure 4-3.

14. Page 4-27/Paragraph 2:

- Arsenic was elevated by 4 orders of magnitude in the second round of ground water sampling as compared to round 1 data.

15. Page 4-27/Paragraph 4:

- The concentrations of leachate indicators (or other parameters) detected in site ground water monitoring wells has no bearing on the volumes of leachate being generated by the landfill. Low level concentrations are more likely related to the age of the landfill as the leachate becomes more dilute with time.

16. Page 4-29/Paragraph 4:

- What is the relationship between ground water flow and these surface water bodies?

17. Page 4-30/Paragraph 3:

- The lateral ground water flow velocity is calculated. Are vertical ground water velocities comparable?

18. Page 4-32/Paragraph 3:

- Do historical records indicate that fly ash disposal occurred at or near site 4?

19. Page 4-41/Paragraph 3:

- There are no wells located downgradient of MW 4-05 to define the extent of TCE contamination in this area.

20. Page 4-44/Figure 4-5:

- MW5-5 shows an incorrectly posted water table elevation.

21. Page 4-52/Paragraph 1:

- There are no wells located downgradient of MW 5-06 to define the extent of TCE, DCE and xylene contamination in this area.

22. Page 4-52 /Paragraph 6:

- The limits of contamination at the landfill boundaries are not fully defined (see comment above). Comments regarding the absence of a major release at this location, therefore, are not based on factual data.

23. Page 4-55/Paragraph 3:

- There are no wells located downgradient of MW7-5 to define the extent of TCA contamination in this area. The occurrence of this compound at sites 4, 5 and 7 suggests that solvents may have been used or disposed of during past site history. A broader perspective on the occurrence of this specific parameter may be warranted at N.W.S.

24. Page 4-64/Paragraph 5:

- See comment two with reference to page 4-27.

25. Page 4-66/Figure 4-7

- Contour lines need to be redrawn to better reflect groundwater elevations in relation to equipotential contour lines. MW10-6 with a groundwater elevation of 101.4 feet is too close to equipotential line 101.0 when compared to MW10-1's 101.1 feet. Their locations in relation to equpotentiual lines should be switched.

26. Page 4-84/Paragraph 3:

- The occurrence of TPH concentration in site soils may be a factor to be considered in the baseline risk assessment relative to the endangered plant species described for this site.

27. Page 4-89/Paragraph 1:

- The occurrence of metals in unfiltered ground water samples provides little information regarding dissolved contaminant transport for risk assessment purposes. Do future plans exist to evaluate metal concentrations in filtered water samples?

28. Page 4-91/Figure 4-9:

- A number of ground water elevations appear to be posted erroneously; also the interpreted ground water flow patterns are unusual and warrant further explanation.

29. Page 4-104/Paragraph 4:

- The occurrence of lead and chromium in unfiltered ground water samples is reported at this and a number of other sites in the RI report. <u>Dissolved</u> metal concentrations should perhaps be evaluated on a site wide basis for risk assessment purposes. Without a baseline of analytical metals data for filtered ground water samples, the question of metals distribution and mobility in the aquifer system cannot be adequately addressed. This appears to be a significant data gap in the RI report.

30. Page 4-109/Paragraph 2:

- See comment above.

31. Page 4-113/Last Paragraph:

- The naturally occurring range of metals in site soils has been alluded to explain nearly every occurrence of metals in all site media tested. Data acquisition methods have apparently failed to distinguish between naturally occurring metals and any which may have been introduced during past site operational activities..

32. Page 4-114/Paragraph 1:

- The section states that semi-volatile compounds detected are constituents of gasoline, motor oils and coal tar. The significance of this remark should be provided.

33. Page 4-115/Paragraph 3:

- There are no wells located downgradient of MW 26-1 to define the extent of TCE contamination in this area. See also last paragraph on page 4-123.

34. Page 5-1/Paragraph 2:

- The grouping of sites for the analysis of contaminant transport analysis and risk assessment is a good strategy and was addressed earlier under the general comments section of this document review. One factor left out of the grouping criteria here, however, is common hydrogeologic/aquifer setting and site proximities to each other. The following bar graph presentations for selected contaminant concentrations at each of the various sites investigated is a step in the right direction towards creating a graphical representation of contaminant distributions at the site. An alternate, and perhaps more interpretable method is to present a specified contaminant's concentrations in bar graph form on a map of the entire site. Computer modeling software packages are available to facilitate the presentation of data in this format, one of which overlays this information on a site water table map for extrapolation of transport pathways. This mapping tool is particularly useful for risk assessment objectives.

"GIS system"

35. Page 5-9/Paragraph 4:

- It is indicated here that the extent of contamination is well defined by sampling results. While this may be apparent to the author, the extent should be clearly defined in the report through the presentation of contaminant plume maps.

EPA Comments

Attachment 2

Groundwater

1. The N.W.S. Earle sites are all located within the boundaries of the New Jersey Coastal Plain Sole Source Aquifer, a groundwater protective designation conferred by Section 1424(e) of the Safe Drinking Water Act. Groundwater at the sites is therefore classified as at least Class IIA Current Source of Drinking Water. Consequently, MCLs are Applicable or Relevant and Appropriate Requirements (ARARs). SDWA is both a chemical and location specific ARAR.

2. As a result of the site's groundwater classification, sub-MCL volatile organic compound (VOC) concentrations determined by an analysis in which the detection limit was greater than the federal MCL should be verified on samples from the same location utilizing the drinking water 500 series analytical method.

3. Apparently, almost all field and blank groundwater VOC and BNA samples collected at the site during each of the three sampling rounds were contaminated by acetone, methylene chloride, bis(2-ethylhexyl)phthalate, or carbon disulfide. The Region II CERCLA QA Manual presents decontamination, glassware, collection, storage, and handling procedures which were developed expressly to prevent this type of contamination and the subsequent inconclusive results. These procedures are considered mandatory for Superfund work within the Region. The persistence of sample and blank contamination through three rounds of sampling strongly suggests sloppy performance of field and laboratory work and/or that inappropriate field and/or laboratory procedures were followed. Also, a few cases do exist where one or more of these compounds were detected in high concentrations in the absence of blank contamination. Nevertheless, the detections are disregarded as probable field or laboratory contamination. The ambiguity which remains regarding organic compound contamination at the Earle site after three sampling rounds emphasizes the necessity of following Region II CERCLA QA procedures without deviation. Since only summary data has been provided, EPA can not ascertain the effect that the persistent sample contamination has had on detection limits for other parameters. It is likely that other contaminants may have been masked, or that dilution raised detection limits far beyond an acceptable range. The previous comment discusses the necessity of utilizing a drinking water methodology for confirming "J" qualified or sub-MCL analytical results. Another groundwater sampling event is clearly required to assess organic compound contamination at the site. In order to assure that interpretable, reliable results are obtained, all field and laboratory procedures must be performed in concurrence with Region II CERCLA QA protocols.

4. The RI report should contain a table listing the analytical methods and method and instrument detection limits.

5. Groundwater contour maps are provided for all individual sites except Sites 20 and 22, and no explanation for the omission of these two areas is advanced. Contour maps should be included in the final RI report for sites 20 and 22, or the reason for their omission should be justified.

6. Raw data used to develop Table 3-3 Summary of Groundwater Elevation Data should be provided in the RI report appendices to permit validation of the calculations and interpretations.

very important

7. The first paragraph of Section 2.1.6.2 Local Hydrogeology at NWS Earle on page 2-14 notes the importance of the Vincentown and Kirkwood formations as sources of potable water. There is no indication of the presence or absence of off-site potable wells proximate to the site. A well survey focusing on wells within a one mile radius of the site should be conducted, and the results provided in the RI report.

8. The second paragraph of Section 2.1.6.2 Local Hydrogeology at NWS Earle on page 2-14 notes the presence of two potable water wells screened in the PRM on the main base. These wells are reported to be currently out of service. The reason for these wells being taken out of service should be discussed. Also, groundwater analytical results from these wells obtained as a part of this or any other sampling event should be included.

9. The final paragraph of Section 2.1.7 Groundwater & Surface Water Quality on page 2-16 states that high levels of nitrate/nitrite "... are generally associated with higher population densities". This statement conflicts with the results presented in the recently published EPA groundwater pesticide survey. The survey results indicate that nitrate/nitrite detections in groundwater samples are generally associated with agricultural areas, which tend to have low population densities. This finding is consistent with the use of nitrogen fertilizers in agriculture. The statement in the document should be amended to reflect the most recent, comprehensive data.

10. Appendix A Boring Logs and Well Construction Summaries does not contain information regarding OVA or HNu results obtained during drilling at all drilling locations. Monitoring for organic vapors during drilling is a Region II SOP. These results should be incorporated into the drilling summaries.

11. The third sentence of the first paragraph of Section 4 Results of the Field Investigation on page 4-1 states that "Data tables summarize significant 'hits'....". However, no criteria for determining "significant" is presented. Moreover, no potential ARARs/TBCs are presented. Consequently, it is not possible to independently validate the conclusions regarding contaminant's distributions. Data tables should be modified to show all contaminant hits. Significance should subsequently be proposed by comparison to potential ARARs/TBCs. A formal risk assessment will ultimately determine whether the detected contaminants pose a hazard to public health and/ or the environment. The "significance" of detected concentrations must not be a subjective parameter determined by the contractor.

12. The discussion of Site 2 results in Section 4.1.2.1 Analysis of Soils and Sediments proposes to compare metal detections to background, but - while noting the heterogeneity of background concentrations at the N.W.S. sites, states that no background samples were collected from Site 2. A surrogate background is then proposed based on literature values for crustal rocks, sediments, and soils in the eastern U.S.. This approach is unacceptable for the determination of site associated contamination. If no background data exists, detections should be compared to potential ARARs/TBCs.

13. The National Primary Drinking Water Standards presented in the Groundwater Sample Analytical Results in Section 4 require correction or enhancement as follows. Groundwater sampling data summaries should also be revised accordingly.

Contaminant	MCL	Non-Zero MCLG
bis(2-ethylhexyl)phthalate[1]	.004	
Methylene Chloride[1]	.005	
Chloroform	.1	
Barium	2	
Beryllium[1]	.001	
Cyanide[1]	.2	
Nickel[1]	.1	
Antimony[1]	.01/.005	.003

1. Proposed MCL therefore a potential TBC.

14. Note that the 15 ug/l value for lead and the 1300 ug/l value for copper are Action Levels (AL) - not MCLs - determined at the tap and thus representing these metals contributions from all sources in drinking water. The AL values are nevertheless ARARs at NPL sites where groundwater is classified as drinking water.

15. The second paragraph on page 4-14 of Section 4.1.3 discusses chromium and lead detections in soils and groundwater at Site 2, where both were detected at concentrations exceeding the federal MCL and AL, respectively. The second sentence states a federal MCL for lead of 50 mg/l which is erroneous: the AL should be substituted.

    The final sentence and the following paragraph inaccurately accuses the analysis of unfiltered samples for the detection of chromium and lead in groundwater. An increasing body of independent, peer reviewed evidence suggests that filterable colloidal metal complexes are highly mobile in groundwater: this is also the justification for mandatory analysis of unfiltered samples in the Region II CERCLA QA manual. The potential for metal species mobility is also increased at lower pH values, and the pH values for Site 2 groundwater were acidic. Arguments should not be advanced which attempt to justify metal contaminant immobility due to the analysis of unfiltered samples. Rather, the evidence supporting the mobility of metals at Site 2 should be presented.

    While metals may not be a component of the explosives detonated at Site 2, containers harboring explosives may have been composed solely or partially of these metals. Also, chromate is an oxidizer, and may be a component of the detonant. These issues may elucidate the source of lead and chromium at Site 2, and therefore demand additional investigation.

16. Metal contaminants have been detected throughout the site. Interpretations of metal mobility presented in the document do not reflect either site specific conditions or current concepts of metal mobility. The U.S. EPA metals speciation model MINTEQ A2 utilizes a thermodynamic data base to predict metal speciation, and is likely the most widely used model for this purpose. MINTEQ A2 can be applied to a variety of environmental problems including aquifer contamination. EPA strongly recommends that the speciation and transport of metal contaminants detected on-site be evaluated via the MINTEQ modeling approach. Use of the predictive tool can provide support for use during the evaluation of remedial action alternatives. The model and extensive user support have been available free of charge. Information and MINTEQ A2 diskettes can be obtained from Dr. David S. Brown, U.S. EPA Environmental Research Laboratory, Athens, GA 30613.

17. Summary tables of analytical sampling results use the NR (Not Requested) qualifier for most replicate samples. It is unclear whether this indicates that replicates were not included in the workplan, or whether the replicate results were not requested. The consistency between replicates is a

principal indicator of the quality of the results. All replicate data should be included.

18. The groundwater elevation for MW3-7 shown on figure 4-2 Generalized Cross Section A-A' is incorrect: the value shown in Table 3-3 indicates that the elevation is 113.3 ft MSL.

19. In the final sentence of Section 4.2.3 Summary of Site 3 Characterization on page 4-27 the word **contaminated** should be inserted before the word **leachate**.

20. Section 4.2.2.2 Analysis of Groundwater at Site 3 discusses arsenic contamination in groundwater samples, but fails to note detection of cadmium, chromium, and lead at concentrations exceeding federal MCLs in several wells. Note that chromium concentrations increased from sub-MCL concentrations to a concentration over six times the federal MCL in MW3-1 between the first and second sampling events, suggesting an existing source. The chromium in this well decreased to about 2.5 times the federal MCL in the third round, suggesting mobility of the contaminant. Table 3-2 only provides data for relatively up-gradient MW3-6, and the pH of the purged water was slightly acidic. Further acidification of groundwater within the waste pile can not be ruled out. Cadmium, chromium, and lead should be considered contaminants of concern (COCs) for Site 3.

21. With respect to Table 4-7a, the federal MCL for cis-1,2-dichloroethylene is 70 ug/l and for trans-1,2 dichloroethylene is 100 ug/l.

22. The final sentence of the third paragraph of Section 4.3.3 Summary of the Site 4 Characterization misinterprets the data. TCE concentrations within the range detected suggest a relatively nearby source of TCE contamination. A general rule regarding concentrations of DNAPL is that 1% (1/100th) of the solubility suggests the presence of a DNAPL pool. For TCE, these values are about 100 and 50 ug/l respectively. Consequently, the possibility of the presence of perched DNAPL or another source at Site 4 must be considered.

23. Table 4-7c on page 4-40 indicates the detection of lead in replicate third round groundwater samples from MW4-4 at concentrations exceeding the federal Action Level of 15 ug/l. Lead was detected in lower concentrations in samples from the first and second sampling round. The potential exists in landfills for the loss of integrity of containers, with resulting contaminant release. The increase in lead concentrations should be considered a red flag signaling that present lead concentrations at this well should be investigated.

24. The second paragraph on page 4-36 of Section 4.3.2.3 Analysis of Groundwater Site 4 discusses the detection of lead in MW4-5. Table 4-7c indicates a lead detection of .014ug/l in a round three sample from this well; zinc was detected at .062ug/l. Either the text or the data summary is incorrect.

25. Figure 4-5 utilizes the groundwater elevation at MW5-1 to support a complicated representation of groundwater flow at Site 5. Additionally, the interpretation encompassing all of the wells appears to violate the laws of physics. The fourth sentence of Section 4.4.1 Physical Characteristics states that the site slopes to the southwest. Well logs from the site indicate generally uniform marine sediments. Figure 2-1 Composite Shallow Groundwater Surface Contour Map for the Main Base shows groundwater at site 5 to be flowing south -southeast to north. In figure 4-5 groundwater is shown to flow to the southeast. Given that the data provided in Table 3-3 and on the figure are correct, and that field personnel accurately determined and recorded the data, EPA concurs that interpretation is difficult. The drilling logs eliminate the possible existence of an underlying depositional formation of relatively high hydraulic conductivity which slopes to the southeast, thereby creating a physical basis for flow "uphill". A possibility for consideration is that groundwater has mounded at the bottom of the hill in response to a physical barrier off the page to the south-west. Contributions to net groundwater flow from another source should also be considered. Wells which are not drilled or installed plumb, or which are screened at different depths relative to a constant datum in cases where vertical flow is significant also impair determination of groundwater elevations. Since a topographical map for the site has not been provided, it is difficult to speculate. EPA does strongly recommend that this violation of physical laws be the subject of additional investigation. Methods for further characterization include investigation of the topography and installation of additional piezometers to the west, east, and south-southeast.

26. Figure 4-5 should be re-oriented so that north is towards the top of the page rather than towards the bottom.

27. The groundwater elevation for MW5-5 on figure 4-5 is given as 193.1 ft MSL. The data in Table 3-3 indicates that the correct value is 93.1 ft MSL.

28. The presentations of results in Section 4.4.2.2 Analysis of Groundwater at Site 5 and Section 4.4.3 Summary of Site 5 Characterization suggest that the author never looked at the data. No mention is made of metal contamination at site 5.

However, throughout the three rounds of sampling, chromium and lead were detected in up to six wells at concentrations exceeding their respective federal MCL/AL. Chromium concentrations were reported at up to 60 times the federal MCL (MW5-6, round 2); lead was detected at concentrations up 6.5 times the Action Level (MW5-6, round 2). Cadmium and Beryllium were also detected in numerous wells at concentrations exceeding their respective federal MCL and proposed MCL. Lead, chromium, cadmium, and beryllium have severely contaminated groundwater at Site 5, and should be COCs. Discussions of groundwater results should primarily focus on the metal contamination.

Solid Waste Landfill Army W. of Bonneville

29. Table 4-9 on page 4-57 indicates bis(2-ethylhexyl)phthalate detections at up to 110 ug/l, but below the detection limit of the analytical method (J qualifier). There is a proposed federal MCL of 4 ug/l for this compound, and the detection limit should be sensitive to at least this value.

30. Sections 4.5.2.2 Analysis of Groundwater at Site 7 and Section 4.5.3 Summary of Site 7 Characterization do not note the detection of arsenic at values which exceed its federal MCL by a factor of almost 4. Arsenic should be added as a COC at site 7.

31. The discussions in Section 4.6.2.3 Analysis of Groundwater at Site 10 on page 4-71, 4-72 notes lead and chromium contamination but fail to note detections of arsenic, beryllium, and cadmium at concentrations exceeding their federal MCL. These contaminants should be added as COCs at site 10.

32. Section 4.6.3 Summary of the Site 10 Characterization proposes that detections of chromium and lead are probably "... a function of ambient soil conditions (natural or broadly impacted by human activities) plus the unfiltered sample protocol, than any past site activities." This use of double-speak is highly misleading. First, lead and chromium are generally not associated with marine sediments thereby ruling out the naturally occurring supposition. Second, to our knowledge the only documented human activities at the site were site activities - operation of a scrap waste landfill. Last, EPA commented previously on the erroneous nature filtered sample argument. Groundwater at this area is moderately acidic which likely supports soluble metal species. Since there is no evidence that only non soluble scrap waste was deposited at Site 10, and since there is no valid off-site background sampling location, contaminants must be assumed to have been associated with past site activities.

33. Figure 4-8 Site 11 Groundwater Surface Contours should be reoriented so that north is toward the top of the page.

34. Chromium and lead were detected at high concentrations, and the argument presented in Section 4.7.3 Summary of the Site 11 Characterization on page 4-89 regarding the source of metals is again inapplicable.

35. The depiction of groundwater flow presented in Figure 4-9 Site 19 Groundwater Surface Contours and the description provided in Section 4.8.1.3 Hydrogeology fails to comprehend the likely nature of flow at the site. The data shown does not support any generalized groundwater flow pattern. Since the predominant lithology at the site is sand with some silty sand, the piezometric head anomalies shown across the site are not directly interpretable from the information provided in the text or on the figure. The likely source of the anomalies is the borehole/well construction. Deviations from plumb are well known sources of piezometric elevation errors. Most likely, however, is the difference in depth of the wells. With the exception of MW19-5, wells showing high elevations are screened at greater depths than wells showing lower elevations. MW19-5 appears to be located under asphalt which may act as a cap thereby reducing the head at that location. Overall, the data suggests that a substantial upward vertical hydraulic gradient exists at the site. The location of the marsh supports this interpretation. Careful installation of a piezometer nest would provide the data necessary to support this likely scenario. EPA recommends that in the absence of a piezometer nest, that groundwater flow be represented with straight lines rather than the bell-shaped contours. The likelihood of a strong upward vertical flow component and groundwater discharge to the marsh should be discussed as supported by the well depth and piezometric head data.

36. Section 4.8.2.2 Analysis of Groundwater at Site 19 on page 4-92, 4-104 does not note the detection of cadmium at concentrations exceeding the federal MCL in each sampling round. Cadmium should be included as a COC.

37. The next to last sentence in Section 4.8.3 Summary of the Site 19 Characterization states that "... the concentrations of these metals in unfiltered samples from the shallow groundwater do not imply significant mobility." The data provided in Table 3-2 indicate that groundwater in this area is acidic, a primary factor in mobilization of metals in water. The statement should be changed to note the high likelihood that metals are relatively mobile at the site.

38. No groundwater sampling was conducted at site 20. However, as opposed to the argument provided in Section 4.9.3 Summary

of Site 19 Characterization on page 4-109, the concentrations of semivolatile organic compounds and metals in the waste pile and sediment do not preclude mobilization to groundwater. Groundwater wells should be installed and sampling of groundwater is justified by the provided results.

39. Section 4.9.3 Summary of the Site (19) Characterization states that organic compounds detected at the site will "naturally degrade over time." Biological mineralization of organic compounds is a complex process which requires the presence of substrates, proper electron donors and acceptors, and nutrients as well as conditions of temperature and pH. The plethora of semivolatile organic compounds detected at this site suggests that at least some enhancement of conditions will be necessary to effect rapid mineralization of contaminants. Also, it will be necessary to provide evidence that the detected contaminants will degrade under similar conditions, e.g., aerobic vs anaerobic. No presumptions regarding the biotransformation of site associated contaminants should be advanced without - at the least - independent peer reviewed documentation.

40. Results presented in Table 4-20a on page 4-118 indicate that cadmium was not analyzed in groundwater samples. The omission of cadmium should be justified.

41. Tables 4-20a requires insertion of the federal MCL for cis-1,2-DCE of 70ug/l and trans-1,2 DCE of 100ug/l.

42. Note that cadmium, chromium, lead, and beryllium were detected at concentrations slightly exceeding the federal MCL in several groundwater samples.

43. The final sentence of Section 4.11.3 Summary of Site 26 Characterization on page 4-123 notes a "... possible tank associated with Building GB-1." there is no indication of whether the tank is still there, whether it is a subsurface or surface tank, whether it is enclosed in the building, the nature of its contents, age, etc. To determine the source of the detected 1,2 DCE contamination in groundwater, this data is essential and should be provided in the site discussion. The location of the tank should be provided on Figure 4-11.

44. Summary tables and figures provided in Section 5 Contaminant Fate and Transport show varying concentrations of metal contaminants in "up-gradient" locations, and proceeding from up-gradient to down-gradient. Due to the anomalies associated with the determinations of groundwater flow directions noted in previous comments, the validity of some "up-gradient" locations remains highly circumspect. The

geology of the Atlantic coastal Plain does not reasonably support high background metal contamination. Discussions with the USGS support our contention that chromium, lead, cadmium, and arsenic are, at most, present at very low parts per billion concentrations in groundwater in the vicinity of the site. Consequently, it appears that groundwater throughout large parts of the facility are moderately to highly contaminated with one or more metals.

Wetlands

1. Site 3 is a 5-acre landfill that was active between 1960 and 1968. A broad drainage swale exists near the southeastern site boundary, and the water table here is about 8 to 12 feet bgs. The swale may be subject to Section 404 and should be described further (e.g., vegetation).

2. Site 4 is a 5-acre landfill that was active between 1943 and 1960. A small stream originates from springs adjacent to the site. An area of common reed (Phragmites) is found along the eastern side of the landfill. Ground water ranges between 0 and 25 feet bgs. EPA suggests that on-site wetlands, as well as off-site wetlands potentially impacted by remediation, be delineated using the 1989 Federal manual.

3. Site 5 is a 13-acre landfill that was active between 1968 and 1978. Hockhockson Brook is about 1000 feet east of the site, but Figure 3-5 shows a possible channel on the site. Ground water occurs 15 to 23 feet bgs. The possible existence of a drainage channel on the site should be clarified.

4. Site 10 is a 2-acre scrap-metal landfill that received wastes from 1953 to 1965. The site is bordered on the east and northeast by a small stream, and groundwater beneath the site occurs at depths between 6 and 12 feet. EPA suggests that any off-site wetlands potentially disturbed by remedial activities be delineated.

5. Site 11 is a 2-acre ordnance disposal area. Groundwater is only 1 to 7 feet bgs, and the Federally Threatened plant species Rhynchospora knieskernii (beaked rush) is present. The site should be examined for wetlands using the 1989 Federal manual.

6. Site 19 is a paint chip and sludge disposal area bordered on the west by a branch of Mingamahone Brook and on the north/northwest by wetlands. The water table on the site is 10 to 14 feet bgs. EPA suggests that off-site wetlands potentially disturbed by remedial activities be delineated.

7. Site 20 is a paint chip disposal area bordered on the northeast by wetlands. EPA recommends that off-site wetlands potentially impacted by remediation be delineated.

8. Site 22 is a paint chip disposal area approximately 25 feet from a possible wetland. EPA suggests that this wetland be delineated if it will be disturbed by remedial activity.

9. Site 26 is a munitions recycling facility bordered on the west by a branch of Mingamahone Brook and on the north by wetlands. Groundwater occurs 10 to 15 feet beneath the site. EPA recommends delineation of off-site wetlands if remedial impacts are anticipated.

10. The Section 404 ARAR requires that impacts to wetlands and other aquatic habitats be avoided or minimized.

Biological Technical Assistance Group

General Comments

1. Using reference or background levels for inorganic compounds as a screening criteria is an established and appropriate methodology. However, these levels should be as local as possible to the sites being investigated. Using "Average Concentration in the Earth's Crust" or "Concentrations in Natural Soils in North America" (pg. 4-7) as screening criteria is inappropriate, especially when inorganics are potentially Contaminants of Concern. Even "...normal concentrations for...soils of the east coast of the United States" (pg. 4-6) is much too broad a range to be used as anything but general information. Reference levels used as general information should come from state or, preferably, county ranges. Screening criteria to be used for eliminating a contaminant from review as a potential risk requiring consideration during the remedial process should only be generated by collecting local samples for reference. A local sample is defined as a location similar to the site that is as close as possible while being beyond any potential influence of site contamination. It is also inappropriate to dismiss a contaminant because it was not "...observed in the form of anomalously high concentrations..." (pg. 4-6) without providing statistical validation that a certain level is or is not elevated. The use of proper reference samples for screening is also a concern for the investigation of the groundwater, as several exceedences of groundwater ARARs were attributed to ambient soil conditions. Care must also be taken that the text discussion of the analytical results does not overlook elevated levels which are reported in the tables.

2. There was inconsistency in the analysis of samples from this site. Some sites were analyzed for Total Petroleum Hydrocarbon (TPH) while others were analyzed for Base/Neutral/Acid

Extractables (BNAs), some for Volatile Organic Compounds but not Semi-Volatile Organic Compounds and vice versa, and some analyses included metals while others did not. This lack of consistency creates a difficulty in interpreting the data presented, and correlating contamination from different sites to broader ecological impacts. Also, variation of the parameters for analysis of samples between different sampling rounds can hinder determinations of the extent of impact from the site and the need for remedial activity.

3. By analyzing the contamination at NWS Earle on a site by site basis, a correlation of the effects of the individual sites on the base's ecosystem as a whole was not addressed. As an example, a definition of the surface water pathways within a specific watershed and the cumulative effects of the individual sites on the watershed was not provided. It would be appropriate to perform an analysis of the watershed itself to address this issue. The information gained from this analysis could then be evaluated considering contaminants associated with each site to investigate correlations between contamination from the sites and effects on the watershed. It would also allow for an examination of the potential for contaminants to migrate off of the site. Additional sediment and surface water sampling would be appropriate to adequately assess these possibilities. To assist in the review for any potential ecological risk from contamination of sediments, it is appropriate to also request analysis of the samples for Total Organic Carbon (TOC) and grain size. The availability of a contaminant to a biological receptor is affected by these parameters and, therefore, this influences the potential for risk.

4. Several references are made to "marshy," "low-lying," wet areas. These areas should be investigated to confirm the presence or absence of wetlands. Wetlands are areas of sensitive habitat which often act as contaminant "sinks" due to such factors as increased sedimentation and deposition of contaminants. The wetland areas on the base that are impacted or potentially impacted by site related contamination or proposed remedial activities should not only be clearly identified, but also delineated. In order to comply with federal wetland ARARs, the three-parameter method, as outlined in the "Federal Manual for Identifying and Delineating Jurisdictional Wetlands" (Federal Interagency Committee for Wetlands Delineation, 1989), should be used to delineate wetlands. Also note that a wetlands assessment and restoration plan will be needed for any wetlands impacted or disturbed by contamination or remedial activities.

5. A federally listed threatened species (Knierskern's beakrush) is referenced in the report (pg. 3-32). Although it appears that some investigation into the presence of threatened and endangered species has been made, it is important to note that compliance

done

with Section 7 of the Endangered Species Act is an ARAR. If it has not yet been initiated, an informal Section 7 Consultation will need to be requested from the United States Fish and Wildlife Service to identify endangered or threatened species which may be associated with these sites. This can be accomplished by contacting the USEPA.

6. The description of the ecological communities was rather meager, including only such references as "grasses," "scrub pines," or "woodlands." A better description, even if only qualitative, of the existing community at each site would be beneficial by allowing review of potential biological receptors and ecological contaminant migration pathways to be considered simultaneous to the review of the data. A concise list of the vegetational community and any wildlife observed or believed to be potentially present should be included. The base biologist referenced on page 3-32 may be able to provide such information without having to require additional field work.

Site Specific Comments

1. Site 2.

The levels of chromium should be compared to a local reference level. As general information, five samples (183 to 286 mg/kg) out of eight exceeded the upper boundary for the range of chromium in New Jersey soils of 5 to 100 mg/kg chromium (Shacklette, H.T. and J.G. Boernges, 1984. Chemical Analysis of Soils and Other Surficial Material of the Conterminous United States, U.S. Geological Survey Open-File Report 81-197), while the remaining three samples (71 to 93.5 mg/kg) all exceed the mean for chromium in New Jersey of 43 mg/kg (ibid.). This exemplifies the need for local rather than regional reference samples. If the soil levels detected on-site are shown to not be within local reference levels and to be site related, then this may call into question the document's conclusion on page 4-14 that "the presence of relatively elevated metals in groundwater samples...appears more a function of ambient soil conditions...than any past site activities."

2. Site 4.

The relation of the detection of PCBs in a sediment sample adjacent to the site is qualified as by the statement that "...PCBs were not found in the test pit samples" (pg. 4-41). A lack of detection of PCBs in the analysis of samples from two of six test pits on a five acre site does not seem to be appropriate justification for suggesting the PCBs may not be site related.

(pg. 4-41). The presence of the PCBs in the sediments of the adjacent stream, and the possibility of the discharge of groundwater containing TCE, DCE, elevated COD, and sulfates to

the stream (pg. 4-36), raises concerns for the potential for ecological impact. The "...broad, low-lying area (with a tall stand of Fragmites [sic]..." (pg. 4-28) should be reviewed as a potential wetland which may be receiving contaminated groundwater.

3. Site 11.

Analysis of samples from this site should be consistent with other sites, including scans for metals and a breakdown of TPH into specific compounds (e.g., PAHs, BNAs). With the presence of the threatened beakrush species, it would be appropriate to provide the ecological risk assessment prior to making the determination that "...impact on this site from past activities is negligible..." (pg. 4-84). While it may be correct that "...the residual hydrocarbons can be expected to naturally degrade over time" (pg. 4-84), a proper review of feasible alternatives for site remediation cannot be made without clarification of the risks involved.

4. Site 19.

It appears that the extensive contamination of this site may be impacting a wetland area. This area should be identified and delineated so that proper consideration of remedial alternatives and potential restoration can be considered during the selection of remedial goals. There should also be a clarification of why there was historical detection of cadmium as high as 31,900 mg/kg (pg. 3-34), yet cadmium was essentially undetected in the latest round of sampling.

5. Site 20.

Based on the elevated levels of metals in the waste piles on this site, and the potential for continued exposure of the environment to potential migration of these contaminants, this site should be reassessed as to the document's apparent dismissal of ecological concerns for this site. Examination of potential groundwater and surface water contamination associated with the site's waste piles should be performed.

Air Programs

1. The report was incomplete in analyzing the air pathway. While the low levels of organics detected should not pose an air problem, the impact of inorganics should be determined since suspension of shallow soils by wind erosion and mechanical disturbances are possible.

2. The emission rate of each semivolatile and non-volatile in the surface soil should be estimated. The emission rates should then be used to model contaminant air concentrations at potential

receptor locations. Attached are procedures EPA suggests be used to perform these analyses. (see Attachment 3).

3. The resulting contaminant concentrations at the receptors should be used as input to the inhalation pathway of the baseline risk assessment.

Attachment 3

where E_i = Emission rate of component i, g/s

C_i = Concentration of component i in the soil pore spaces, g/cm^3

V_y = Mean landfill gas velocity in the soil pore spaces, cm/s (default = 1.63×10^{-3} cm/s average)

A = Exposed surface area, cm^2.

Note: The default value of V_y is an average value. Various site factors such as saturated soils will tend to reduce the rate of volatilization. The degree to which this model is able to accurately predict release rates under conditions of moist or wet soils is unknown. Under such conditions, emission flux measurements at soil surfaces may be necessary.

Reference for Step III,1,2,&3: *SEAM*, Section 2.3.2.1., April 1988.

4. Free-phase Volatile Contaminants Directly Exposed to the Atmosphere:

For any and all free-phase volatile contaminants directly exposed to the atmosphere, in-depth APA is warranted. Source monitoring is recommended to determine emission rates, supplemented by ambient monitoring and/or refined modeling. Applicable situations include open drums/containers, fresh spills, etc. where free product exists.

5. Solids and Semivolatiles Emitted as Particulate Matter:

A. For solids and semivolatile contaminants with air release potential (e.g., metals, semivolatiles, and pesticides adsorbed to fugitive dust, etc.), measure contaminant-specific bulk concentrations of erodible surface materials.

Note: If onsite data are not available, assume that the contaminant concentrations measured from bulk samples of surface materials are constant across the entire soil particle size range.

For estimating emissions from wind erosion, either of two emission flux (g/m^2-h) models are used depending on the erodibility classification of the site surface material. These two models are: 1) "unlimited reservoir," and 2) "limited reservoir." Each site surface of homogeneous contaminant concentration must be placed into one of these two classifications. The following decision flowchart (Figure 1) is used to determine: 1) whether no

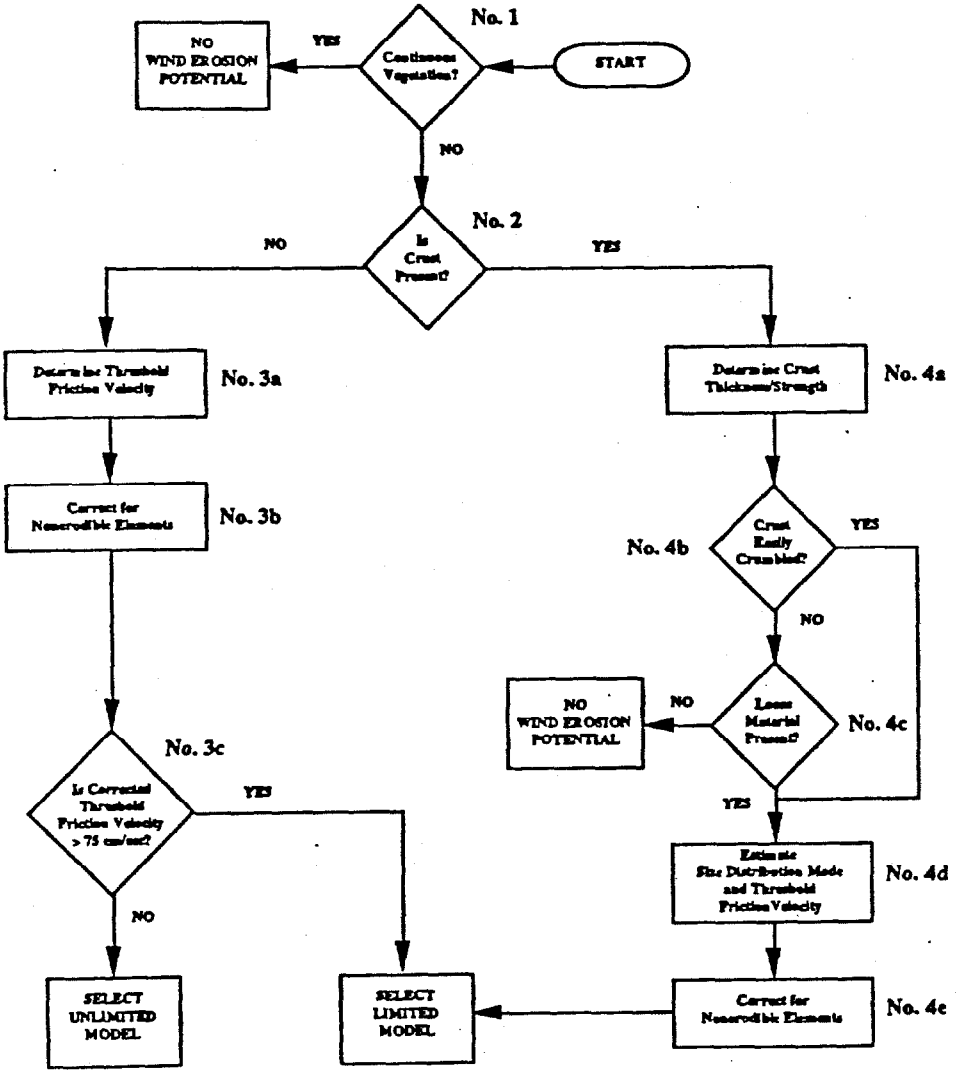


Figure 1. Decision flowchart.

wind erosion potential exists, or 2) which of the two emission flux models is applicable for site conditions. The instructions within each box of the flowchart are detailed in the list of steps following the flowchart.

It should be noted that the two emission flux models (Equations 15 and 18) represent average annual emissions. This assumes continuous emissions over time. In actuality, emissions do not occur except during periods when the windspeed meets or exceeds the threshold friction velocity for the given soil particle size. A continuous average emission flux is calculated to account for a continuous exposure interval (i.e., hours/day x days/year x years).

Detailed Steps for Flowchart:

No. 1 Continuous Vegetation?

Continuous vegetation means "unbroken" vegetation covering 100 percent of the site or site sector to be analyzed.

No. 2 Is Crust Present?

Crusted surfaces are regarded as having a "limited reservoir" of erodible particles. Check for crust thickness/strength during the site inspection.

No. 3a Determine Threshold Friction Velocity

Threshold friction velocity (u'_t) is that wind velocity at which erodible site particles are suspended. To determine u'_t, the mode of the surface aggregate size distribution must be determined. The distribution mode is the particle size containing the highest percentage of material from a representative sample. This can be determined with a field sieving procedure as follows:

1. Prepare a nest of sieves with the following openings: 4 mm, 2 mm, 1 mm, 0.5 mm, and 0.25 mm. Place a collector pan below the bottom sieve (0.25 mm opening).

2. Collect a sample representing the surface layer of loose particles (approximately 1 cm in depth for an uncrusted surface), removing any objects larger than about 1 cm in average physical diameter (nonerodible material). The area to be sampled should not be less than 30 cm x 30 cm.

3. Pour the sample into the top sieve (4 mm opening), and place a lid on top.

4. Rotate the covered sieve/pan by hand using broad sweeping arm motions in the horizontal plane. Complete 20 rotations at a speed just necessary to achieve some relative horizontal motion between the sieve and the particles.

5. Inspect the relative quantities of catch within each sieve and determine where the mode in the aggregate size distribution lies, i.e.., between the opening size of the sieve with the largest catch and the opening size of the next largest sieve (e.g., 0.375 mm lies between the 0.5 mm and the 0.25 mm sieve).

With the aggregate size distribution mode, determine the threshold friction velocity (u'_t) in cm/s from the relationship in Figure 1a.

No. 3b Correct for Nonerodible Elements

Mark off a representative site area 1m x 1m and determine the fraction of total area, as viewed from directly overhead, that is occupied by nonerodible elements (e.g., stones, clumps of grass, etc.). Nonerodible elements can be said to exceed 1 cm in diameter. Correct the overhead fractional area of nonerodible elements to the equivalent projected frontal area. An example would be that a spherical stone with an area of 10 cm^2 as viewed from overhead but half-buried in the soil, would have a frontal projected area of 5 cm^2. Determine the ratio of the frontal projected area of nonerodible elements to the total overhead area of the erodible soil. This ratio (L_t) is used with the relationship shown in Figure 1b to determine the appropriate correction factor. Multiply u'_t by the correction factor to obtain the corrected threshold friction velocity (u^*_t).

Note: If data for determining L_t is not available, a conservative default value of 0.01 may be used for nonsmooth soil surfaces. This results in a correction factor of approximately 1.5.

No. 3c Is Corrected Threshold Friction Velocity >75 cm/s?

75 cm/s is an empirical number determined through observation of actual soil types.

No. 4a Determine Crust Thickness/Strength

and

No. 4b Crust Easily Crumbled?

If the crust thickness is <0.6 cm or if the crust can be easily crumbled by hand pressure it exhibits a potential for wind erosion.

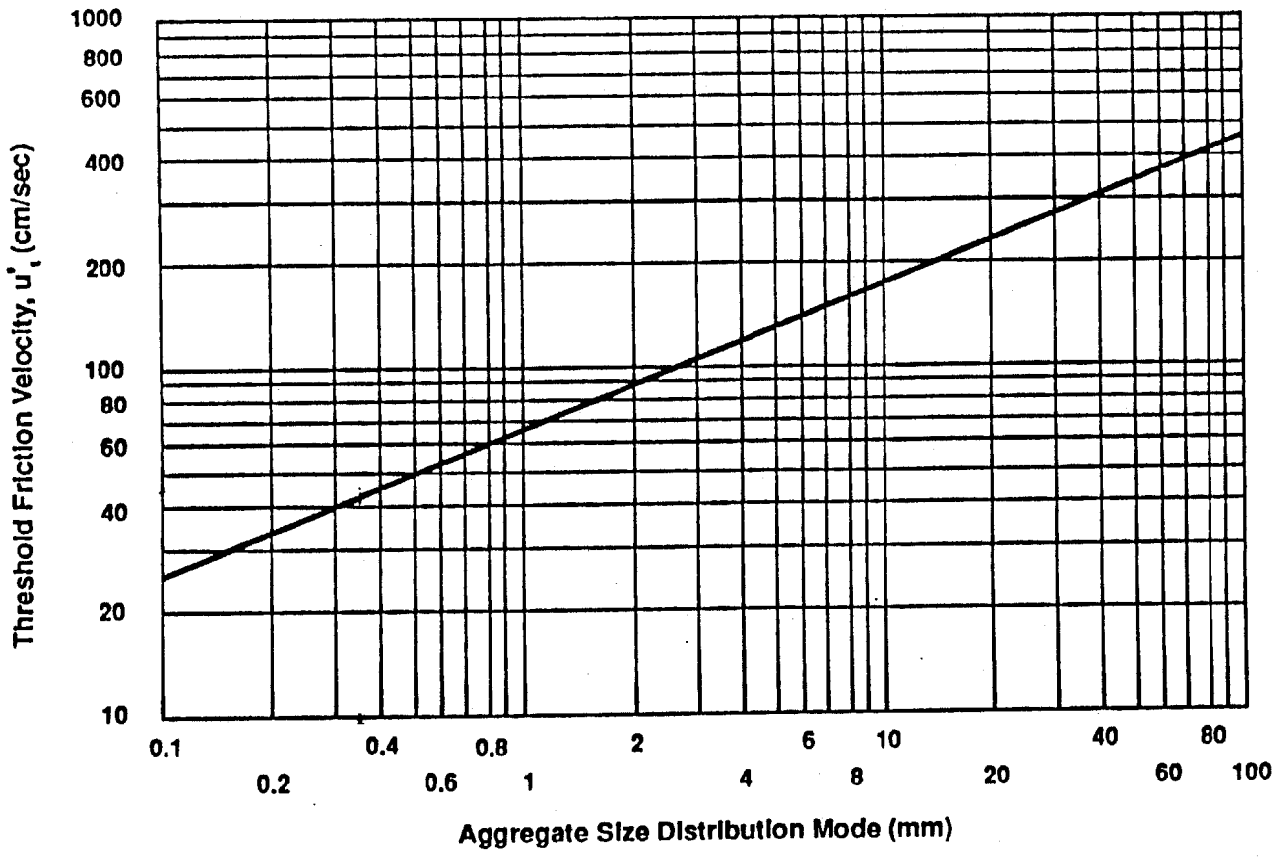


Figure 1a. Threshold friction velocity versus aggregate size distribution.

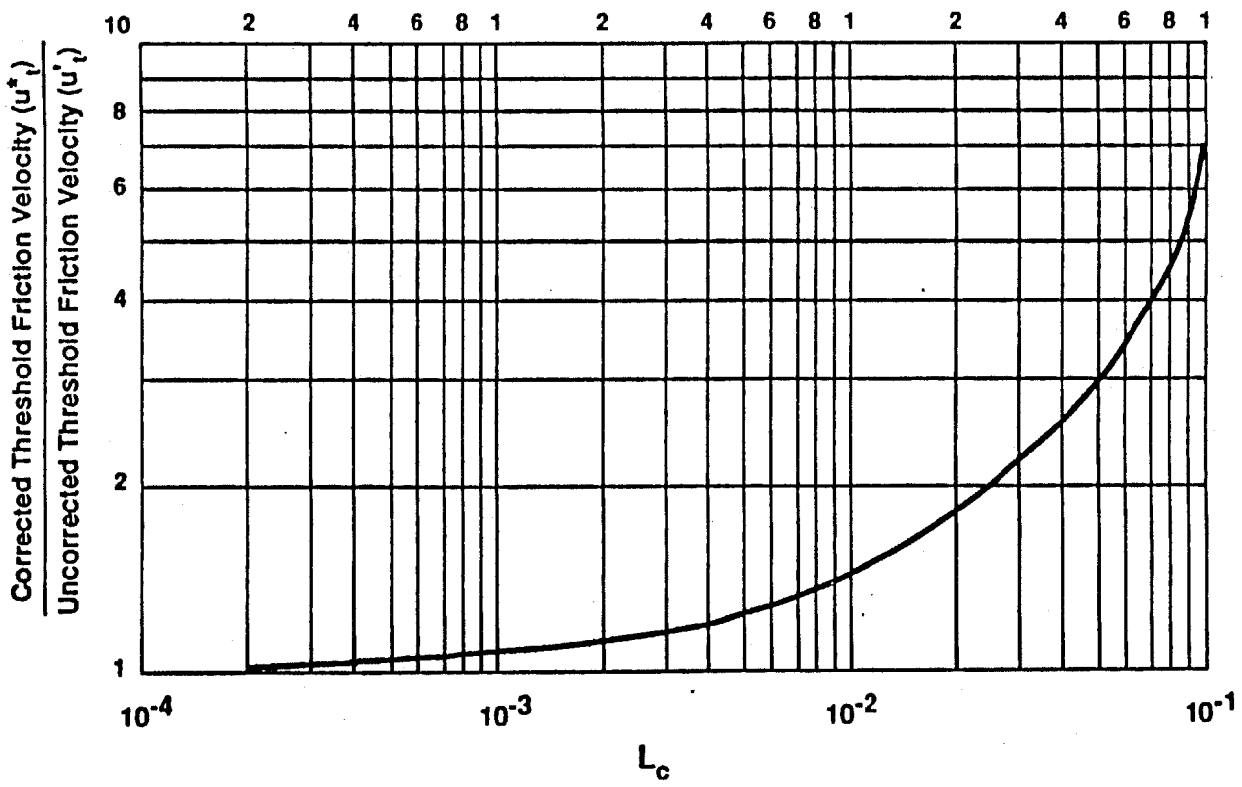


Figure 1b. Increase in threshold friction velocity with L_c.

No. 4c Loose Material Present?

Determine if there is loose erodible material above any hardened crust.

No. 4d Estimate Size Distribution Mode and Threshold Friction Velocity

Estimate the aggregate size distribution mode of the loose material above the hardened crust and determine the threshold friction velocity (u'_t) (Step 3a).

No. 4e Correct for Nonerodible Elements (u^*_t)

(Step 3b)

B. Using either the "unlimited reservoir" or the "limited reservoir" model as determined from Figure 1, calculate an annual average emission flux (g/m^2-h) for each contaminant found in the erodible surface material.

1. Using the "unlimited reservoir" model

a. Emission flux for inhalable particles $\leq$ 10 μm (PM_{10}):

$$E_{10} = 0.036\ (1-V)\left(\frac{[u]}{u_t}\right)^3 F(x)\ C \qquad (15)$$

where E_{10} = PM_{10} annual average emission flux of component i, g/m^2-h

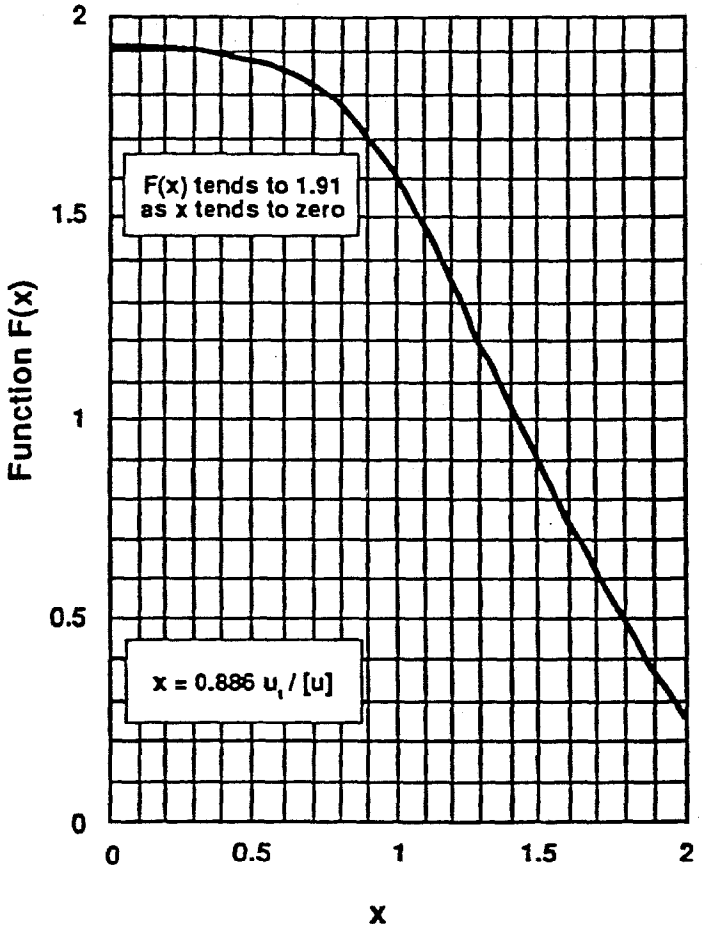
V = Fraction of contaminated surface with continuous vegetative cover (equals 0 for bare soil)

[u] = Mean annual windspeed at 10 m anemometer height, m/s (from local climatological data)

u_t = Equivalent threshold value of windspeed at 7 m anemometer height, m/s (Equation No. 16)

C = Fractional percent by weight of component i from bulk samples of surface material

F(x) = Function obtained from the relationship in Figure 2 ($x=0.886\ u_t/[u]$, dimensionless ratio).



NOTE: If $x > 2$,
$F(x) = 0.18\,(8x^3 + 12x)\,e^{-x^2}$

Figure 2. Function curve used in "unlimited reservoir" model.

Calculation of the equivalent threshold value of windspeed at a 7 m anemometer height (u_t):

$$u_t = 18.1\ (u^*t)/100 \qquad (16)$$

where u_t = Equivalent threshold value of windspeed at a 7 m anemometer height, m/s

(u^*_t) = Threshold friction velocity corrected for nonerodible elements, cm/s (5.A, detailed Steps 3a and 3b)

Note: This calculation is based on an assumed roughness height for flat terrain of 0.5 cm, between natural snow (0.1) and a plowed field (1.0). Refer to the reference for Step III.5. to calculate u_t if a roughness height of 0.5 cm is not appropriate for site-specific conditions.

b. Emission flux for particles $\leq 30\,\mu$m (for deposition modeling):

$$E_{30} = E_{10} \times 2 \qquad (17)$$

where E_{30} = Annual average emission flux of component i as particles $\leq 30\,\mu$m, g/m^2-h

E_{10} = PM_{10} annual average emission flux of component i, g/m^2-h (Equation No. 15).

2. Using the "limited reservoir" model.

a. Emission flux for inhalable particles $\leq 10\,\mu$m (PM_{10}):

$$E_{10} = 0.83 \frac{(f)\ P(u^+)\ (1-V)\ (C)}{(1000)\ (PE/50)^2} \tag{18}$$

where E_{10} = PM_{10} annual average emission flux of component i, g/m^2-h

f = Frequency of disturbances per month (1/month for abandoned sites or sites with no activity)

u^+ = Observed (or probable) fastest mile of wind (at 10 m anemometer height) for the period between disturbances, m/s (from local climatological data)

$P(u^+)$ = Erosion potential, i.e., quantity of erodible particles at the surface prior to the onset of erosion, g/m^2 (Equation No. 19 or 19a)

V = Fraction of surface area covered by continuous vegetation (equals O for bare soil)

C = Fractional percent by weight of component i from bulk samples of surface material

PE = Thornthwaite's Precipitation-Evaporation Index used as a measure of soil moisture content (Figure 3).

Calculation of erosion potential [$P(u^+)$]:

$$P(u^+) = 6.7\ (u^+ - u_t)\ for\ u^+ \geq u_t \tag{19}$$

$$P(u^+) = O\ for\ u^+ < u_t \tag{19a}$$

where $P(u^+)$ = Erosion potential, g/m^2

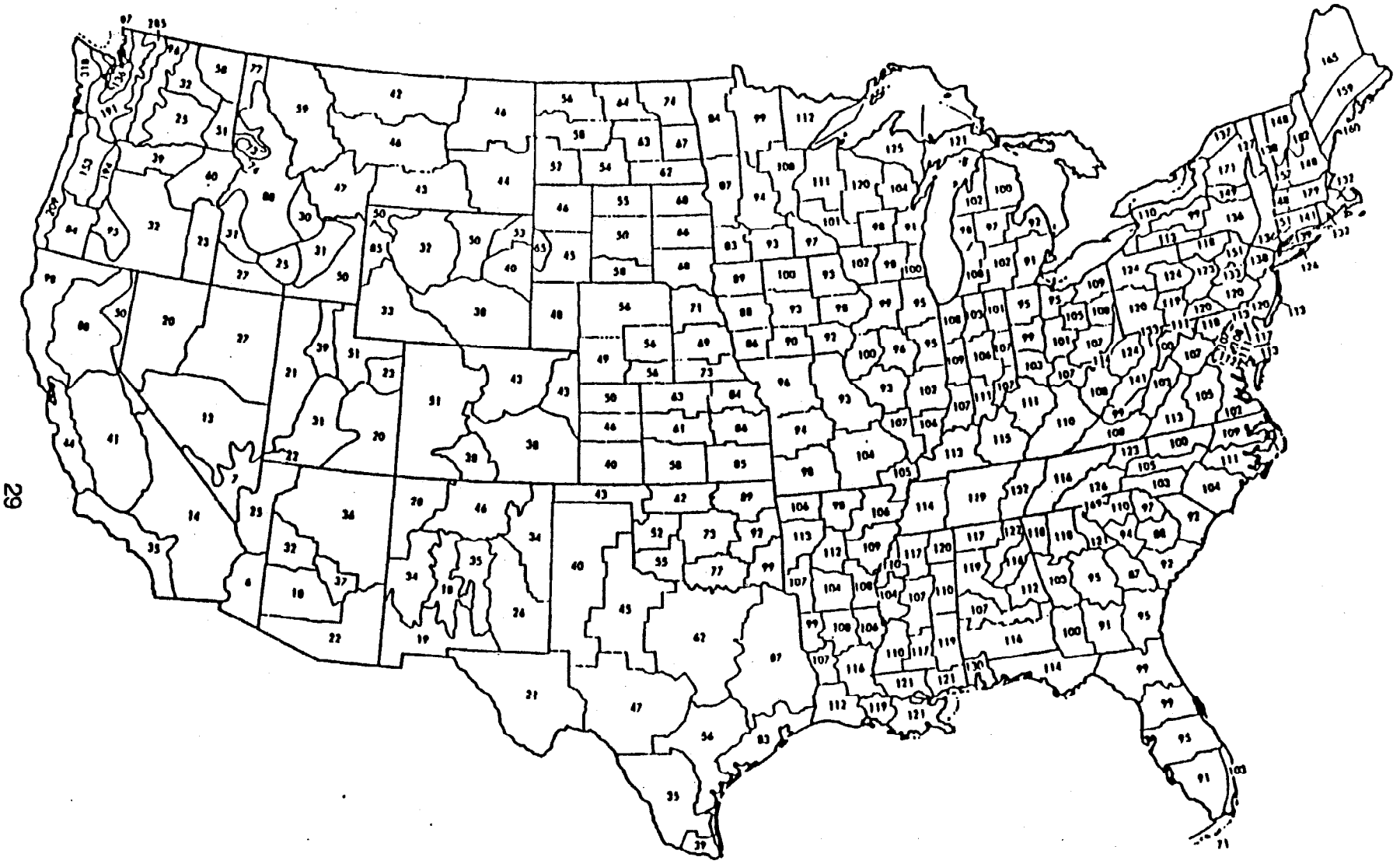


Figure 3. Thornthwaite's Precipitation-Evaporation Index (PE) for State Climatological Divisions.

u^+ = Observed (or probable) fastest mile of wind (at 10 m anemometer height) for the period between disturbances, m/s (from local climatological data)

u_t = Equivalent threshold value of windspeed at a 7 m anemometer height, m/s (Equation No. 16).

b. Emission flux for particles $\leq 30\,\mu m$ (for deposition modeling):

$$E_{30} = E_{10} \times 2 \tag{20}$$

where E_{30} = Annual average emission flux of component i as particles $\leq 30\,\mu m$, g/m^2-h

E_{10} = PM_{10} annual average emission flux of component i, g/m^2-h (Equation No. 18).

Reference for Step III.5: *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites*, Sections 1 - 4.1.2. Office of Health and Environmental Assessment, Washington, DC. EPA-600/8-85/002. February 1985.

C. Calculate a total emission rate (g/s) of each contaminant from the emission flux rate using the following formula:

$$E_T = \frac{E_x A}{3600} \tag{20a}$$

where E_T = Annual average emission rate of component i for particles $\leq x\,\mu m$, g/s

E_x = E_{10} or E_{30} emission flux obtained from Equation Nos. 15, 17, 18, or 20, g/m^2-h

A = Contaminated surface area, m^2.

Reference for Step IV.1.C: *Workbook*. Appendix E.

Reference for Annual Point Source Multiplying Factor: *Estimation of Air Impacts From Air Stripping of Contaminated Water*. Air/Superfund NTGS Series, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-450/1-91-002. NTIS PB91-21888, May 1991. (The referenced value is presently under review and subject to change.)

D. Estimate downwind annual average concentrations for area sources using the following procedures:

1. Estimate the combined area source size by summing the sizes of all individual area sources.

2. Determine the square area of the combined area source (example: 2,500 m^2 = 50 m x 50 m).

3. Determine the total annual emission rate for the combined area source and convert to kg/m^2-yr.

4. From the set of curves in Figure 4, locate the χ/Q value for the appropriate downwind receptor distance and source size.

5. Multiply the χ/Q value (10^{-9} yr/m) by the annual emission rate per square meter, Q (kg/m^2-yr) to derive the annual average concentration, χ ($\mu g/m^3$) for the combined source.

Note: For downwind distances <50 meters and for onsite receptors, the model presented in the following step (Step IV,1,E) may be used.

Reference for Step IV.1.D: *Hazardous Waste TSDF-Fugitive Particulate Matter Air Emissions Guidance Document*, Appendix C. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-450/3-89-019. NTIS PB90-103250. May 1989.

E. If the receptor is located at the edge of the area source or within the contaminated area, use the following procedure to estimate the annual average concentration at the center of the area source.

Given the horizontal dimension of the square area source (X in meters) and the total source emission rate (Q_T in g/s):

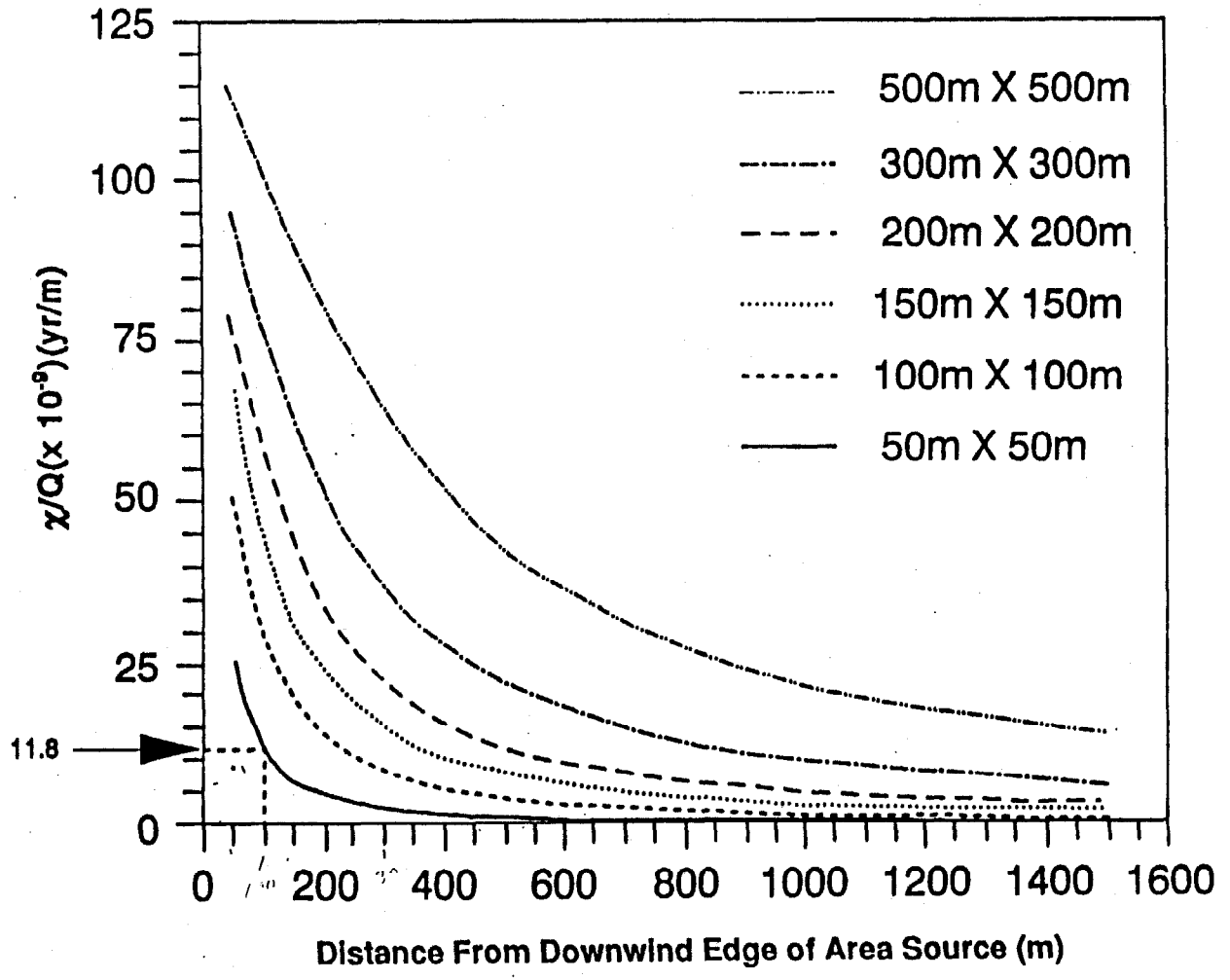


Figure 4. χ/Q versus distance for six area source sizes.

1. Determine the natural logarithm of the horizontal dimension of the subject area source (lnX).

2. Enter the value produced in (1) above into the following polynomial equation to produce the natural logarithm of the normalized concentration:

$$\ln(C/Q_T) = 13.0 - 0.261(\ln X) - 0.241(\ln X)^2 + 0.0124(\ln X)^3$$

3. Take the exponential of the value produced in (2) above to produce the normalized concentration:

$$C/Q_T = e^{\ln(C/Q_T)}$$

4. Multiply the normalized concentration by the emission rate to produce the long-term (annual average) concentration in $\mu g/m^3$:

$$C = (C/Q_T)Q_T$$

Note: The above polynominal equation is based on the modeling results of progressively larger square area sources utilizing the U.S. EPA Point-Area-Line (PAL) dispersion model. A single receptor was located at the center of each source negating the effects of wind direction. Windspeed was set at 2 m/s and atmospheric stability was set at Pasquill-Gifford class D (neutral) as typical average annual values. Emissions are assumed to be continuous, uniform over the surface of the area, nonbuoyant, inert, and emitted at a concentration less than approximately one percent (10,000 ppmv), so that density differences relative to air are not important. These procedures may not be conservative for sites in very sheltered locations where windspeeds may average less than 2 m/s and/or where very stable conditions may be typical. In these cases, refined modeling and/or monitoring may be required.

The procedures in Step IV,1,D and E are presently under review and subject to change.

Reference for Step IV.1.E: Memorandum from Robert Wilson, U.S. EPA, Region X Meteorologist, to Pat Cirone, Chief, Health and Environmental Assessment Section. June 1991.

2. If the Baseline Risk Assessment ultimately indicates that the incremental or aggregate risk for carcinogenic contaminants from onsite incidental ingestion of contaminated soil exceeds the acceptable risk range (i.e., 10^{-4} to 10^{-6}) or if the

Hazard Index for noncarcinongenic contaminants for the same pathway exceeds unity, determine the deposition concentration (g/m^2) of each applicable contaminant at receptors of interest. Deposition concentrations are used to calculate exposures from atmospheric deposition of contaminants. Applicable pathways may include incidental ingestion of soil, uptake in edible biota, indoor exposures due to track-in of outdoor dustfall, etc.

A. Model the particulate emissions of each applicable contaminant using the EPA Industrial Source Complex (ISC) model or the EPA Fugitive Dust Model (FDM) to determine deposition concentrations.

Reference for Step IV.2.A. *User's Guide for the Fugitive Dust Model (FDM) (Revised), User's Instructions*, U.S. EPA, Region X, Seattle, Washington. EPA-910/9-88-202R. NTIS PB90-215203, PB90-502410 (program diskette). January 1991.

Reference for Step IV.2.A: *Industrial Source Complex (ISC) Dispersion Model User's Guide-Second Edition (Revised)*, Volumes I, II, and User's Supplement. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-450/4-88-002a and 002b. NTIS PB88-171475, PB88-171483, and PB88-171491. December 1987.

Note: The most recent and fully capable editions of ISC and FDM may be obtained free of charge from the SCRAM Bulletin Board at (919) 541-5742.

B. For sites that are suspected of having deposited contaminants (especially low mobility contaminants) offsite over an extended period of time, measure contaminant-specific concentrations of surface materials at receptors of interest. The potential contributions from other sources in the area (if any) should be considered and separated from the analysis.

STEP V. COMPARE AMBIENT AIR CONCENTRATIONS TO AIR ARARs AND TBCs

1. From dispersion modeling results performed in Step IV, compare estimated ambient air concentrations with air ARARs and/or TBCs listed in Step II. Comparisons must be made on a chemical-specific basis and estimated concentrations must represent the same averaging time(s) as the ARARs/TBCs (e.g., annual average, 24-h average, etc.).

   Note: Most ARAR's specify that the applicable standard must be complied with at the point of public access. For ground level nonbouyant sources this will be the site fenceline. For such ARARs, dispersion modeling must include such a receptor whether or not the receptor also represents the maximum exposed individual.

2. If any air ARAR or TCB is exceeded, an in-depth air pathway analysis is warranted which may include in-depth modeling and/or air monitoring.

Ecological Assessment of Superfund Sites: Overview

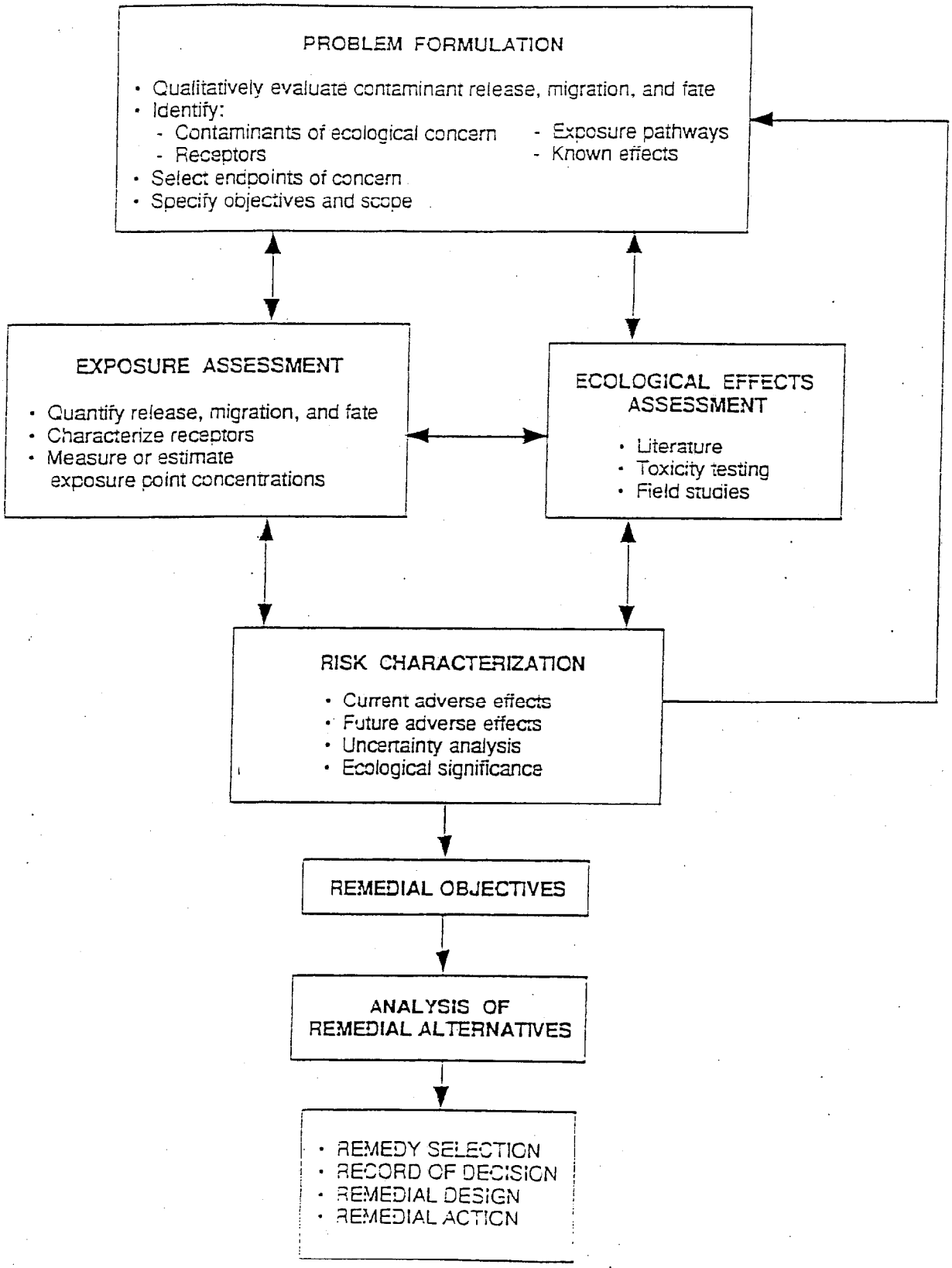



Figure 1