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THE MEMPHIS DEPOT
TENNESSEE

ADMINISTRATIVE RECORD
COVER SHEET

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FINAL

FOCUSED FEASIBILITY STUDY: DUNN FIELD

FOR

DEFENSE DISTRIBUTION MEMPHIS, TENNESSEE MEMPHIS, TENNESSEE

Contract No. DACA 87-90-D0030

PREPARED FOR

U.S. ARMY CORPS OF ENGINEERS
HUNTSVILLE DIVISION
Huntsville, Alabama

SUBMITTED BY

ENGINEERING-SCIENCE, INC.
St. Louis, Missouri

July 1994

DEFENSE LOGISTICS AGENCY
DEFENSE DISTRIBUTION DEPOT MEMPHIS
2163 AIRWAYS BOULEVARD
MEMPHIS, TENNESSEE 38114-5210

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IN REPLY REFER TO DDMT-DE

DEC 0 5 1994

SUBJECT: Transmittal of Environmental Science's *Focused Feasibility Study: Dunn Field*, July 1994

TO: Ms. Martha Berry
U.S. Environmental Protection Agency
Federal Facilities Branch
345 Courtland Street N.E.
Atlanta, GA 30365

Dear Ms. Berry:

1. Defense Depot Memphis, Tennessee (DDMT) is pleased to transmit Environmental Science's *Focused Feasibility Study: Dunn Field*, July 1994 for official transfer to the DDMT repositories. This document has now been superseded by the final Proposed Groundwater Action Plan, but is still to be used as a reference document with the following changes:

a. The Engineering Report for the Dunn Field Groundwater Removal Action will be retitled to: "Focused Feasibility Study: Dunn Field, July 1994."

b. References to an Engineering Evaluation and Cost Analysis (EECA) in the Focused Feasibility Study are no longer applicable.

c. On Page 11-2, the reference to the EECA and the suggested remedy are no longer applicable.

d. Comments from the Tennessee Department of Environment and Conservation, and responses to those comments, are attached to this letter and are considered part of the amended Focused Feasibility Study.

DEC 0 5 1994

SUBJECT: Transmittal of Environmental Science's Focused Feasibility Study: Dunn field, July 1994

2. Please note that the final Proposed Groundwater Action Plan will also be placed in the repositories, so that the public may have a current understanding of the planned activities by reading the proposed plan and the amended Focused Feasibility Study.

Sincerely,

Frank Novitzki

FRANK NOVITZKI
DDMT Project Manager

cc:
TDEC (J. English)

Defense Depot Memphis, Tennessee (DDMT)
Response to
Tennessee Department of Environment and Conservation (TDEC)
Division of Superfund
Comments for the
Draft Final
Engineering Report
Removal Action for Ground Water
7/12/94

The Tennessee Division of Superfund (TDSF) Memphis Field Office (MFO) has reviewed the Draft-Final Engineering Report, Removal Action for Ground Water for the Defense Depot (Site) in Memphis, Shelby County, Tennessee which was received, in part, in their office on 8/17/93. Sections 7 & 8 were missing from the original transmittal but were received after request on 7/8/94.

To expedite the groundwater Interim Remedial Action (IRA), DDMT will respond to TDEC's comments in the Proposed Plan and in future documents. As discussed by TDEC and DDMT in the October 20, 1994, Project Manager's meeting, the Engineering Report will not be revised, but DDMT has prepared a written response to each comment below.

DDMT Response to TDEC General Comments:

TDEC's concerns are addressed by the preferred alternative presented in the Proposed Plan. The preferred alternative consists of a line of recovery wells located downgradient of the leading edge of the plume. This system will contain the plume thus reducint the potential for contaminants to migrate to the Memphis Sand Aquifer.

General Comments:

TDSF's greatest concern is that only one of the alternatives retained, and none selected, adequately address the contaminants that may have previously migrated away from Dunn Field. The perception is that the intent is to allow these potential contaminants to attenuate and continue to migrate and potentially contaminate other portions of the fluvial aquifer or the Memphis Sand aquifer.

TDSF does not intend to concur with any IRM alternative that fails to address this issue. Public acceptance of this is unlikely if communicated properly.

DDMT Response to TDEC General Comments:

TDEC's concerns are addressed by the preferred alterantive presented in the proposed plan. The preferred alternative consists of a line of recovery wells located downgradient of the leading edge of the plume. This system will contain the plume, thus reducing the potential for contaminants to migrate to the Memphis Sand Aquifer.

Specific Comments:

1. Section 1.0, Page 1-2--No alternative was developed which involved Off-site extraction wells.

   DDMT response to TDEC Comment 1. The Proposed Groundwater Action Plan (Proposed Plan) for Dunn Field was developed after the draft Engineering Report was submitted. The Proposed Plan developed a preferred groundwater removal option that includes extraction wells just downgradient of the leading edge of the contaminant plume emanating from the Fluvial Aquifer beneath Dunn Field. The goal of this action is to contain the Fluvial Aquifer contaminant plume and to prevent any further offsite migration. The locations of these recovery wells will be determined after the offsite extent of the contaminant plume is evaluated. The extent of contamination will be evaluated by installing and sampling offsite monitoring wells to the west of Dunn Field, as described in the Operable Unit (OU)-1 Field Sampling Plan (FSP).

2. Section 1.0, Page 1-2--The word "some" is vague and unclear. TDSF suggests replacing with the word "limited".

   DDMT response to TDEC Comment 2. Implementing the preferred alternative in the Proposed Plan will provide control of contaminated groundwater adjacent to government property because the recovery wells will be located downgradient of the leading edge of the plume.

3. Figure 3.2, Page 3-4--Although the map legend does not indicate a contour interval, the interval appears to be 10'. In the lower left of the map, two closed loop contours are not marked. This actually appears to be an error in contouring.

   DDMT response to TDEC Comment 3. Concur. Future contour maps will adequately address the contouring in the southwest corner of Dunn Field.

4. Section 3 .4.1, Page 3-9--The wording ", the thick confining layer of the Flour Island Unit (150+ feet)," should be inserted between "depth_and because".

   DDMT response to TDEC Comment 4. Concur. Future discussions of the Fort Pillow Sand Aquifer will include this phrase.

5. Section 3.4.2, Page 3-9--The statement "No interconnections have been found between the Memphis Sand and the Fluvial Aquifer in the DDRC vicinity." is misleading and borders on deceit. Indications are that a window does exist. Insertion of "conclusive proof of" between "No_interconnections..." would make this a legitimate statement.

DDMT response to TDEC Comment 5. Concur. Discussions of site hydrogeology in the final versions of the OU FSPs and the Generic RI/FS Work Plan will indicate that there is potential interconnection between the Fluvial Aquifer and the Memphis Sand Aquifer beneath DDMT.

6. Section 3.4.2, Page 3-11--In the discussion of the Jackson/Upper Claiborne Formation no reference is made regarding the proximity of the Allen well field, its potential or actual effect on head differences between the fluvial and Memphis Sand aquifers. . Normally, without the drawdown effect of the Allen well field on the Memphis Sand, the Memphis Sand head might be positive relative to the fluvial aquifer.

DDMT response to TDEC Comment 6. Concur. The "bullseye" in the Fluvial Aquifer potentiometric surface map at DDMT (map to be included in the final versions of the FSPs and the Generic RI/FS Work Plan) is a result of the downward vertical component of hydraulic gradient between the Fluvial Aquifer and the Memphis Sand Aquifer. The downward hydraulic gradient is a result of lowered head in the Memphis Sand Aquifer as compared to the head in the Fluvial Aquifer. The lowered head in the Memphis Sand Aquifer is caused by pumping of the nearby Allen Well Field. This discussion will be included in the RI report.

7. Section 3.4.2, Page 3-11--This section is labeled Site Hydrogeology (emphasis added). It is misleading, with the information presented to date, to suggest that the Memphis Sand aquifer is under confined conditions. The inclusion of the word "generally" would be appropriate if qualified with the indications of where it is not certain (Law Study potentiometric map).

DDMT response to TDEC Comment 7. Concur. This comment will be incorporated into future discussions of hydrogeology at DDMT. Areas where there is uncertainty about whether the Memphis Sand Aquifer is confined will be discussed.

8. Section 3.4.2, Page 3-1 1--The Passage "Water levels in the two Memphis Sand wells...suggest a gradient..." is incorrect. The water levels at two wells cannot suggest anything but a relative gradient between each other.

DDMT response to TDEC Comment 8. Concur. The paragraph also should include information on heads of the Memphis Sand Aquifer at the Allen Well Field to the west of DDMT, which are lower than the heads in the two onsite

Memphis Sand Aquifer monitoring wells. This would suggest a hydraulic gradient toward the Allen Well Field to the west of DDMT. This discrepancy will be addressed in future discussions of the hydraulic gradient of the Memphis Sand Aquifer beneath DDMT.

9. Figure 3.6, Page 3-12--Site numbers are illegible.

 DDMT response to TDEC Comment 9. Concur. A larger scale will be used for this figure in future documents.

10. Section 3.5, Page 3-13--In the discussion of volatile organic compounds the statement is made that the plumes appear aligned with the north and west property lines. According to the map on page 3-14 this is clearly not the case for 1,1,2,2-tetrachloroethane. When generalizing you must clarify your generalizations and clearly present any exceptions.

 DDMT response to TDEC Comment 10. Concur. Future discussions of volatile organic compound (VOC) plumes at Dunn Field will be clarified.

11. Section 3.5, Page 3-16--In the discussion of the Memphis Sand aquifer two unsupported statements are made. They both are related to gradient determination. As stated previously, water level measurements from only two wells will not determine true groundwater gradients. It only can be said which well is more upgradient/downgradient than the other. Any other statements regarding gradients relative to the Site or contaminants sources is inconclusive and therefore potentially misleading.

 DDMT response to TDEC Comment 11. Concur. Please see DDMT response to TDEC Comment 8.

12. Section 4.1, Page 4-1--It is possible that Memphis has been surpassed by Nashville in terms of population.

 DDMT response to TDEC Comment 12. The most recent census data will be used in future discussions of the population of Memphis versus other cities in Tennessee.

13. Section 4.2, Page 4-2--Although it is agreed that a transport mechanism at Dunn Field at least includes meteoric infiltration, gravity flow alone can be a transport mechanism. If drum rupture or leakage occurs during dry periods then at least initial transport can be entirely by gravity flow alone.

 DDMT response to TDEC Comment 13. Concur. Future discussions of the identification of exposure pathways at Dunn Field will include gravity flow as a transport mechanism.

14. Section 4.2, Page 4-2--Evidence that there is a potential window between aquifers should be provided here to the extent that it relates to Memphis Sand recharge.

DDMT response to TDEC Comment 14. Concur. Future discussions of the identification of exposure pathways at Dunn Field will include evidence of a potential window existing in the Fluvial Aquifer beneath DDMT (see DDMT response to TDEC Comment 5).

15. Section 4.2, Page 4-4--The level of acetone found in MW-37 is generally well above levels indicative of laboratory contamination. The presence of acetone in similar levels in lab blanks would have supported your theory. It must be noted that historical acetone storage occurred at the Depot near the location of this well.

DDMT response to TDEC Comment 15. ESE conducted a groundwater quality monitoring event in January 1994, after the Engineering Report was submitted. The January 1994 sampling event did not detect acetone in MW-37. Additional data to be collected during the RI will be used to evaluate if the acetone detect in MW-37 from the 1990 Law study was lab contamination or actual site contamination. After further evaluation, a determination can be made about whether acetone should be listed as a contaminant of concern.

16. Section 4.3, Page 4-5--"PTW" should be spelled out followed by the abbreviation for later referral.

DDMT response to TDEC Comment 16. Concur. This acronym will be spelled out in future documents.

17. Section 4.5, Page 4-9--It sounds as though you are looking for an excuse not to include metals as contaminants of concern. The fact that for two consecutive years metals were detected above MCL's indicates the probability that they indeed <u>are</u> contaminants of concern. The fact that they were not detected above MCL's in 1992 indicates that the most contaminated portion of the plume may have migrated off-Site. No information is provided in this passage to indicate if samples were collected during similar seasons. Variations could be seasonal (wet vs. dry) or represent container leakage events.

DDMT response to TDEC Comment 17. Concur. The issue of metals contamination in the Fluvial Aquifer beneath Dunn Field continues to be a concern. This issue will be addressed during design of the Dunn Field Groundwater Removal Action and during the RI activities.

18. Section 4.5, Page 4-10--Consistent with the previous comment this aquifer also contains metals until proven otherwise.

DDMT response to TDEC Comment 18. Concur. Please see DDMT response to TDEC Comment 17.

19. Section 5.0, Page 5-1--Response objective 3 should be reworded to say "*Contain* contaminant migration from beneath Dunn Field to off Site areas,".

DDMT response to TDEC Comment 19. Concur. Please see DDMT response to TDEC Comment 1.

20. Section 5.2, Page 5-7--The statement regarding metals observed during the 1992 pump test are misleading. Pump test observations are not comparable to static observations. One other round of sampling may not be sufficient to confirm no metals problem (see comment for Page 4-9 above).

DDMT response to TDEC Comment 20. Concur. Please see DDMT response to TDEC Comment 17.

21. Section 5.2, Page 5-7--Who made the determination that acetone was not a contaminant of concern? TDSF does not necessarily concur.

DDMT response to TDEC Comment 21. Please see DDMT response to TDEC Comment 15.

22. Section 6.1.2, Page 6-3--Failure to identify the plume boundaries and install appropriate extraction wells to capture "front edge" of the plume will, in effect, put into place a remedy that allows at least partial attenuation. This should be clearly stated here so that the public will have the opportunity to comment.

DDMT response to TDEC Comment 22. Concur. Please see DDMT response to TDEC Comment 1.

23. Section 7.2, Page 7-3, Bullets at top of page--Was any consideration given to modeling with an intermediate grid (ie. between 1200-3400 feet)?

DDMT response to TDEC Comment 23. The preferred alternative for the Dunn Field groundwater removal action will use the observational approach (see Proposed Plan). The observational approach will not rely on modeling alone. Modeling, if used during the approach, will be coupled with actual field data. The field data will come from the operation of an initial recovery well that will be located on Dunn Field. The determination of the locations and spacing of the offsite containment wells will rely on the actual field data from this initial well, coupled with possible additional modeling.

24. Section 7.4.2, Page 7-12--The primary problem is that the plume is ill-defined. With the proper arrangement of on-Site and off-Site extraction wells any migration of contaminants off-Site would be captured.

DDMT response to TDEC Comment 24. Concur. Please see DDMT response to TDEC Comment 1.

25. Section 7.6.1, Page 7-14--"RI report" in the first sentence should be changed to Law Study.

DDMT response to TDEC Comment 25. Concur. Future references to the Law study will not be called the RI.

26. Section 7.6.1, Page 7-14--A statement in this paragraph indicates that other privately-owned water supply wells screened in the Memphis Sand are "at some distance away". Please be specific with regard to this distance.

DDMT response to TDEC Comment 26. Concur. Future discussions on the effects of pumping scenarios will reference the specific locations of other privately owned water supply wells.

27. Table 8.1, Page 8-2--Why is municipal sewer the only disposal option for alternative 3?

DDMT response to TDEC Comment 27. Please see the discussion of disposal alternatives in the Proposed Plan. On the basis of groundwater quality data currently available, it does not appear that groundwater treatment will be required for discharge to the city sewer. However, if treatment becomes necessary to meet city discharge limits, it will be provided. Also, a cost-effectiveness analysis will be performed to determine whether direct discharge (with treatment, if necessary) through an NPDES-permitted outfall is more cost-effective.

28. Section 8.2, Page 8-5--Expected concentrations would also be less due to dilution with "drawn-in" uncontaminated groundwater.

DDMT response to TDEC Comment 28. Concur.

29. Section 9.0, Page 9-2, Middle of upper paragraph--In the sentence that begins with "However, any such agreement...", what agreement is being referred to?

DDMT response to TDEC Comment 29. Please see the applicable or relevant and appropriate requirement (ARAR) discussions in the OU FSPs and the generic work plans.

30. Section 9.0, Page 9-3--Two typos occur on this page. On the top line the word considered is misspelled. About six lines down "willbe" should be separated.

DDMT response to TDEC Comment 30. Concur.

31. Section 9.0, Page 9-8--In the middle of the last paragraph the sentence beginning with "No well constructed..." is a run-on sentence.

DDMT response to TDEC Comment 31. Concur.

32. Section 10.1, Page 10-1--It states that the other alternatives provide effective control of contaminated groundwater beneath the northern portion of Dunn Field and beneath off-Site land *immediately* (emphasis added) land north and west. How immediately? If plume contaminants above MCL's are not going to be contained it should be accurately explained.

DDMT response to TDEC Comment 32. Please see DDMT response to TDEC Comment 1.

33. Section 10.1, Page 10-3--What about past releases from Dunn Field? What is the eventual fate of these contaminants? DLA should candidly explain these points to the public.

DDMT response to TDEC Comment 33. Please see the discussion in the Proposed Plan on the Summary of Site Risks. Past releases will be contained by the groundwater recovery system.

34. Section 10.2, Page 10-3--In the first paragraph the reference is again made to "ground water beneath Dunn Field". The entire aquifer system(s) in the area must be protected from Site impacts not just "beneath Dunn Field".

DDMT response to TDEC Comment 34. Please see DDMT response to TDEC Comment 1.

35. Section 10.6, Page 10-6--It may be surprising how quickly negotiations can obtain easements. TDSF can assist if necessary. A Commissioner's Order can be requested requiring access.

DDMT response to TDEC Comment 35. Concur. The DDMT will assume that property access issues will not hinder the progress of offsite investigations.

36. Section 10.7, Page 10-7--Please clarify why extraction wells would need to be spaced more closely when reinjecting.

DDMT response to TDEC Comment 36. Please see the discussion of alternatives in the Proposed Plan. The Proposed Plan does not include in the cost estimate the issue of requiring closely spaced extraction wells if reinjection is used.

37. Section 10.9, Page 10-10--Is the 90 pounds per year in water or air?

DDMT response to TDEC Comment 37. Please see the Proposed Plan. Air stripping was not included in the preferred alternative.

38. Section 10.9, Page 10-10--If reservations can be addressed through pre-treatment prior to POTW discharge why can't pre-treatment prior to surface water discharge address reservations also?

DDMT response to TDEC Comment 38. Please see the Proposed Plan. Pre-treatment was not included in the preferred alternative.

39. Table 10.3, Page 10-12--The biggest problem with the alternatives retained is the fact that none of them protect the Memphis Sand aquifer down-gradient from Dunn Field from past releases. This will have to be clearly and unambiguously explained to the public.

DDMT response to TDEC Comment 39. Please see DDMT response to TDEC Comment 1.

DISTRIBUTION LIST

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ENGINEERING-SCIENCE, INC.

400 Woods Mill Road South Suite 330 • Chesterfield, Missouri 63017-3427 • Telephone (314) 576-7330 • Fax: (314) 576-2702

1 July 1994

Commander
U.S. Army Corps of Engineers
Attn: CEHND-PM-AE (J. Romeo)
106 Wynn Drive
Huntsville, Alabama 35805-1957

RE: Final Engineering Report, Removal Action for Ground Water
Defense Distribution Memphis, Tennessee
Contract DACA87-90-D-0030
ES-SL016.23

Dear Mr. Romeo:

Engineering-Science, Inc. (ES) is pleased to submit the revised Final Engineering Report, Removal Action for Ground Water at Defense Distribution Memphis, Tennessee (DDMT) under the above referenced contract. This report has been prepared in response to comments from your agency dated 2 May 1994.

ES appreciates this opportunity to serve the Huntsville Division. If you have any questions about this work, please give me a call.

Yours truly,

ENGINEERING-SCIENCE, INC.

David E. Mizell

David E. Mizell, P.E.
Project Manager

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1.0 EXECUTIVE SUMMARY

Defense Distribution Memphis, Tennessee (DDMT) proposes to install an interim ground water pumping and treatment system to control ground water contamination beneath the Dunn Field area. Volatile organic compounds (VOCs) have been found in monitor wells in the unconfined Fluvial Aquifer beneath the northwest part of Dunn Field since 1989. While the extent of contamination is not fully known, DDMT proposes to install a pumping and treatment system as an initial measure until the full extent of contamination has been defined.

The objective of this Removal Action is to mitigate off-site migration of contaminants and to treat, on an interim basis, ground water contaminated with VOCs and metals to below USEPA and State of Tennessee action levels. This action is being undertaken as a non-time critical removal action under CERCLA to treat ground water contaminants in the fluvial aquifer and prevent possible human exposure. When the full extent of contamination has been defined, DDMT will cooperate with State and Federal regulators to select a permanent remedial measure.

Metals in the aquifer were above action levels in 1989 and 1990, but below action levels in 1992. Sampling and analysis for metals in 1993 confirmed that metals were below action levels. Therefore, groundwater treatment in this action focuses on VOCs.

A variety of technologies were examined to achieve extraction and treatment of contaminated ground water, followed by disposal of treated water. These technologies included air stripping, UV/oxidation, and *in situ* methods of treatment for VOCs. Seven alternatives were developed using suitable technologies:

1) No Action

2) Extract ground water using pumping wells located within Dunn Field, treat using air stripper techniques, followed by disposal into the municipal sewer system.

3) Extract ground water using pumping wells located within Dunn Field and off Government property, treat using air stripper techniques, followed by disposal into the municipal sewer system.

4) Extract ground water using pumping wells located within Dunn Field, treat using UV/oxidation techniques, followed by disposal into the municipal sewer system.

5) Extract ground water using pumping wells located within Dunn Field, treat using air stripper techniques, followed by disposal into surface drainage.

6) Extract ground water using pumping wells located within Dunn Field, treat using UV/oxidation techniques, followed by disposal into surface drainage.

7) Extract ground water using pumping wells located within Dunn Field, treat using air stripper techniques, followed by reinjection into the Fluvial Aquifer.

These alternatives were evaluated for protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility and volume; short-term effectiveness; implementability; cost; state acceptance; and community acceptance.

A hydrologic evaluation of these control options was performed using the ground water model DREAM. An extraction system utilizing eight wells located in Dunn Field and penetrating into the Fluvial Aquifer provides control of contaminated ground water beneath Government property, and provides some control of contaminated ground waters adjacent to Government property. Using two extraction wells off-site modifies the control pattern for contaminated ground water, but does not significantly enhance capture in those areas. Further investigation and delineation of contaminated areas off site is required before an effective off-site control strategy can be defined. Disposal of treated water by reinjection into the Fluvial Aquifer accelerates the removal of contaminants in ground water beneath Dunn Field, but reduces the capture of off-site contaminants.

The preferred alternative is Alternative 5, in which water is extracted on-site and treated using air stripping, followed by discharge to surface water discharge. This alternative is responsive to protecting human health and the environment, complying with ARARs, and is effective in the short-term. This alternative offers the fewest obstacles to implementation, is cost-effective, and would appear acceptable to both the State and the community.

STATEMENT OF INTENT AND REGULATORY BASIS

This Engineering Report (ER) is intended to meet all requirements of the Engineering Evaluation/Cost Analysis (EE/CA) under CERCLA and the National Contingency Plan (NCP) for a non-time critical removal. All work relating to the proposed removal action was initiated by DDMT in 1991. This work included: preparation of a pump test work plan (which was approved by both the U.S. Environmental Protection Agency, Region IV, and the Tennessee Department of Environment and Conservation); performance of an aquifer pump test; a report on the results of the aquifer pump test; this report; and an Environmental Assessment (EA) to investigate and document possible effects on the environment resulting from this removal action. The next phase of this project will be the design of the preferred alternative followed by the construction of the preferred alternative. The purpose of this removal action is to treat ground water contaminants in the fluvial aquifer and prevent further migration of contaminants to greatly reduce the threat of possible human exposure.

This document will be released for public comment in accordance with CERCLA and the National Environmental Policy Act (NEPA). A responsiveness summary/response to comments will be prepared following the public comment period. Comments from the public and the regulatory community will be either incorporated into the documents or a valid reason why the comment cannot be incorporated will be provided. The term "Interim Remedial Measure" (IRM) is used in this report as a descriptor of the preferred alternative. The equivalent CERCLA terminology for "IRM" is "removal action." Reviewers of this report should be aware that the preferred alternative will be implemented under CERCLA and NCP provisions that permit the facility (DDMT) to perform a removal action. DDMT intends to remain as the lead agency in implementing this preferred alternative and will cooperate with other Federal, State, and local agencies to accomplish this task.

2.0 SCOPE OF SERVICES

This Engineering Report is the result of conceptual design activities to develop an Interim Remedial Measure for ground water contamination at DDMT. The services performed during this activity are described as follows:

1) Develop Work Plan - A Work Plan was developed for installation of one pump test well and three nearby observation wells into the Fluvial Aquifer beneath the northwest corner of Dunn Field. Existing nearby wells were also available to serve as observation wells.

2) Install Pump Test Well and Observation Wells - Wells were drilled to a depth of approximately 80 feet below the land surface. Chemical samples of soil cuttings were collected and analyzed for organic and inorganic constituents, and these results were used to develop data for the Interim Remedial Measure.

3) Perform Pump Test - A step-drawdown test and a 42-hour pump test was conducted to determine aquifer properties. A sustained flow rate of 24 gallons per minute (gpm) created a drawdown of 4.1 feet at the end of the test. Three chemical samples of the pump test water contained VOCs. Water was treated using activated carbon units and contained for further testing prior to release. Three samples of this water exhibited no significant contamination.

4) Pump Test Data Analysis - Pump test data was examined using the Theis Method, Cooper and Jacob Method, and Neuman's Method modified by Boulton. The estimated yield of this well was 75 gpm and would have a radius of influence of 420 feet. These findings were presented in a Pump Test Technical Memorandum (1992 ES).

5) Determine Ground Water Cleanup Levels - Contaminated ground water shall be treated to cleanup levels satisfying federal, state and local requirements. Cleanup levels are presented in this report to satisfy these requirements.

6) Evaluate Treated Ground water Disposal Options - Options to dispose of contaminated ground water include discharge to a publically-owned treatment works (POTW), discharge to surface drainage, reinjection back into the Fluvial Aquifer, and trucking off-site for disposal. These options are evaluated in this report.

7) Determine Air Emissions Requirements - The presence of VOCs in the contaminated ground water will create emissions to the atmosphere following extraction. This report examines emission standards for the IRM, and describes actions to meet regulatory requirements.

8) Evaluate Hydrologic Impacts - The hydrologic impacts of candidate extraction systems are described in this report. Recommendations are presented for extraction well locations. The impacts of re-injection are also evaluated.

9) Determine Permit Requirements - Permit requirements for the construction and operation of the IRM have been defined through contacts with regulatory agencies. DDMT will comply with substantive ARAR's identified by Federal, State, and local agencies. Section 121(e) of CERCLA exempts any response action conducted on-site from having to obtain a Federal, State, local permit. Under the Clean Water Act, operation of the preferred alternative would be considered to be a direct discharge. By EPA definition, direct discharge of wastewater is considered to be on-site if the receiving water body is in the area of contamination or is in very close proximity to the site and is necessary for implementation of the response action (even if the water body flows off-site).

10) Recommend Treatment Alternative - The best IRM alternative shall be recommended based upon economics, technical feasibility, regulatory requirements, and environmental impacts.

11) Develop Cost Estimate for Alternatives - Cost estimates for the IRM alternatives are developed and presented in this report.

3.0 SITE CHARACTERIZATION

3.1 Site Location and History

DDMT is situated on 642 acres of federal land in the city of Memphis, Shelby County, Tennessee. Figure 3.1 shows the location and layout of DDMT. DDMT consists of two sections: the main installation, which is intensely developed, and Dunn Field, an open storage area about 64 acres in size located north of the main installation. The installation lies in the south central section of Memphis, 4 miles southeast of the central business district and 1 mile north of the Memphis International Airport. DDMT is in a mixed residential, commercial, and industrial area.

Defense Depot Memphis began operations in 1942 with the mission to inventory and supply materials for the U. S. Army. In 1964, the Depot's mission was expanded to include a complete range of commodities for Department of Defense activities, under the auspices of the Defense Supply Agency, now known as the Defense Logistics Agency (DLA). The Depot became known as Defense Distribution Memphis, Tennessee (DDMT) in 1993.

DDMT warehouses and distributes an extensive inventory of supplies to U.S. military services and federal agencies. These supplies span a broad range of commodities including clothing, food, medical supplies, electronic equipment, petroleum products, and industrial chemicals.

Until 1970, hazardous and nonhazardous materials whose containers were damaged or whose shelf life had expired were occasionally burned and/or buried in a portion of Dunn Field. Wastes disposed of in this manner included: oil and grease, paint and paint thinner, methyl bromide, pesticides, herbicides, and food supplies. Other wastes

Figure 3.1

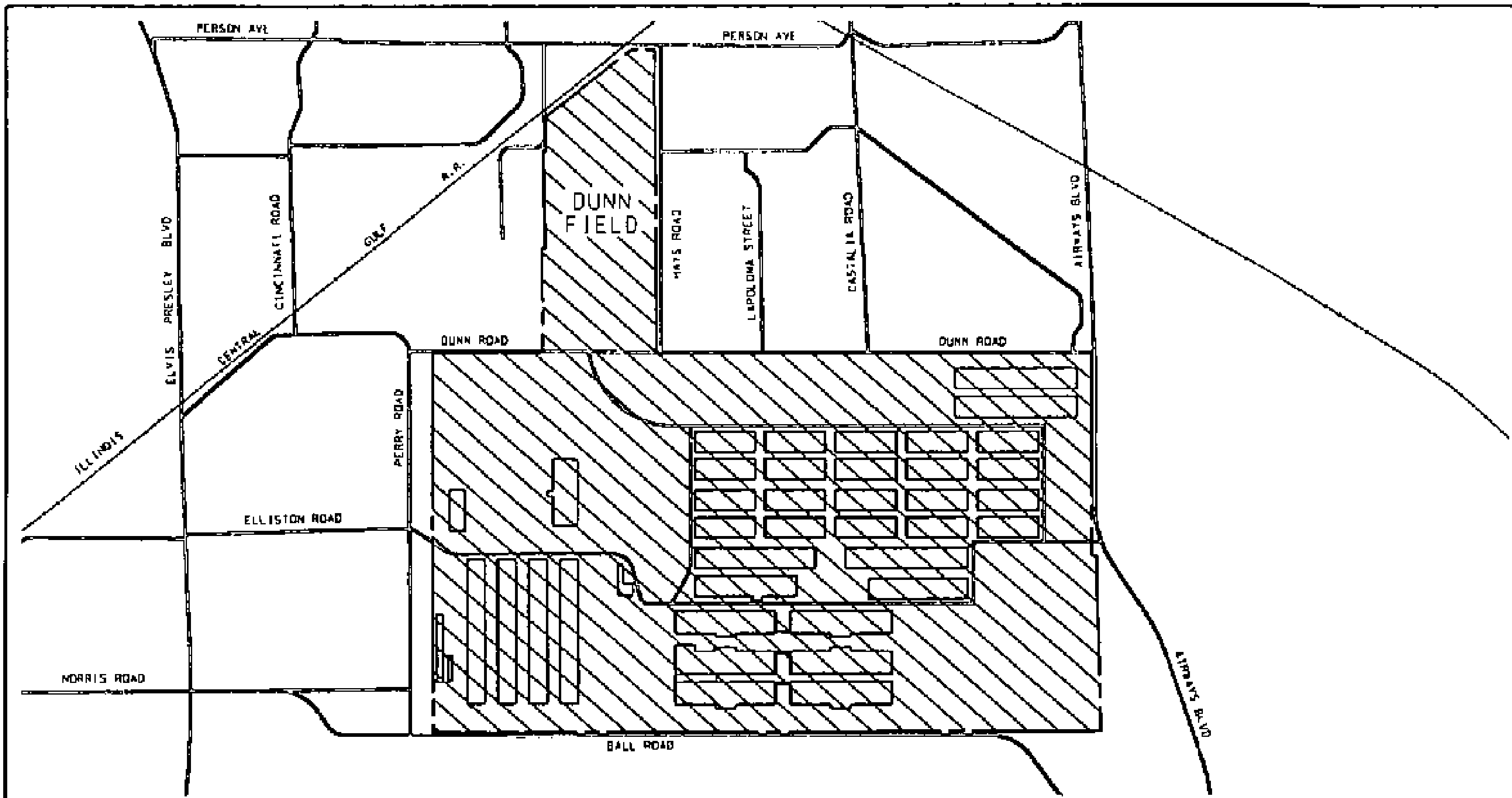

FIGURE 3.1:
LOCATION OF
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MEMPHIS, TENNESSEE

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MEMPHIS, TENNESSEE

DEFENSE LOGISTICS AGENCY

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St. Louis, Missouri

ES

included minute quantities of mustard and lewisite gases contained in nine training canisters. Most of the documented hazardous materials which were disposed during this period were buried in the northwest portion of Dunn Field.

3.2 Topography and Geology

The topography of Dunn Field can be characterized as a level to gently rolling open area. Figure 3.2 shows the ground surface contours around Dunn Field recorded in feet above Mean Sea Level. Dunn Field is unpaved; about half of the area is grass covered and the other half is gravel parking or material storage. An arc-shaped ridge separates the northeast quadrant from the remainder of Dunn Field. From the ridge and the northeast corner of Dunn Field, the terrain gently slopes toward a naturally occurring drainage ditch which conveys runoff northward off the installation. The northwest quadrant of Dunn Field, formerly used for burial of hazardous and non-hazardous materials, is a level to gently sloping grassy area. The southwest quadrant is grassed and gently sloping. The southeast quadrant of Dunn Field is level and is used for open and covered storage of bulk materials.

The Dunn Field area of DDMT is covered by loess deposits, which are underlain by the Fluvial Deposit, the Jackson Clay/Upper Claiborne Group, and the Memphis Sand (1990 Law). More information about these units is summarized below:

- Loess - Directly underlying the Dunn Field is loess, a semi-cohesive wind-blown deposit of silt, silty sand, and silty clay. It is about 20 feet thick in the Dunn Field vicinity and may occasionally reach 30 feet in thickness. Thin, discontinuous fine grained sand lenses may occur locally within the loess.

- Fluvial Deposit - Underlying the loess is the fluvial deposit. This unit consists of a top layer of silty clay, silty sand, or clayey sand; a clean, fine to medium-grained sand; and a basal gravelly sand. While the gravelly sand layer frequently occurs below the fine sand layer, some borings at DDMT exhibit additional fine sand layers below the gravelly sand.

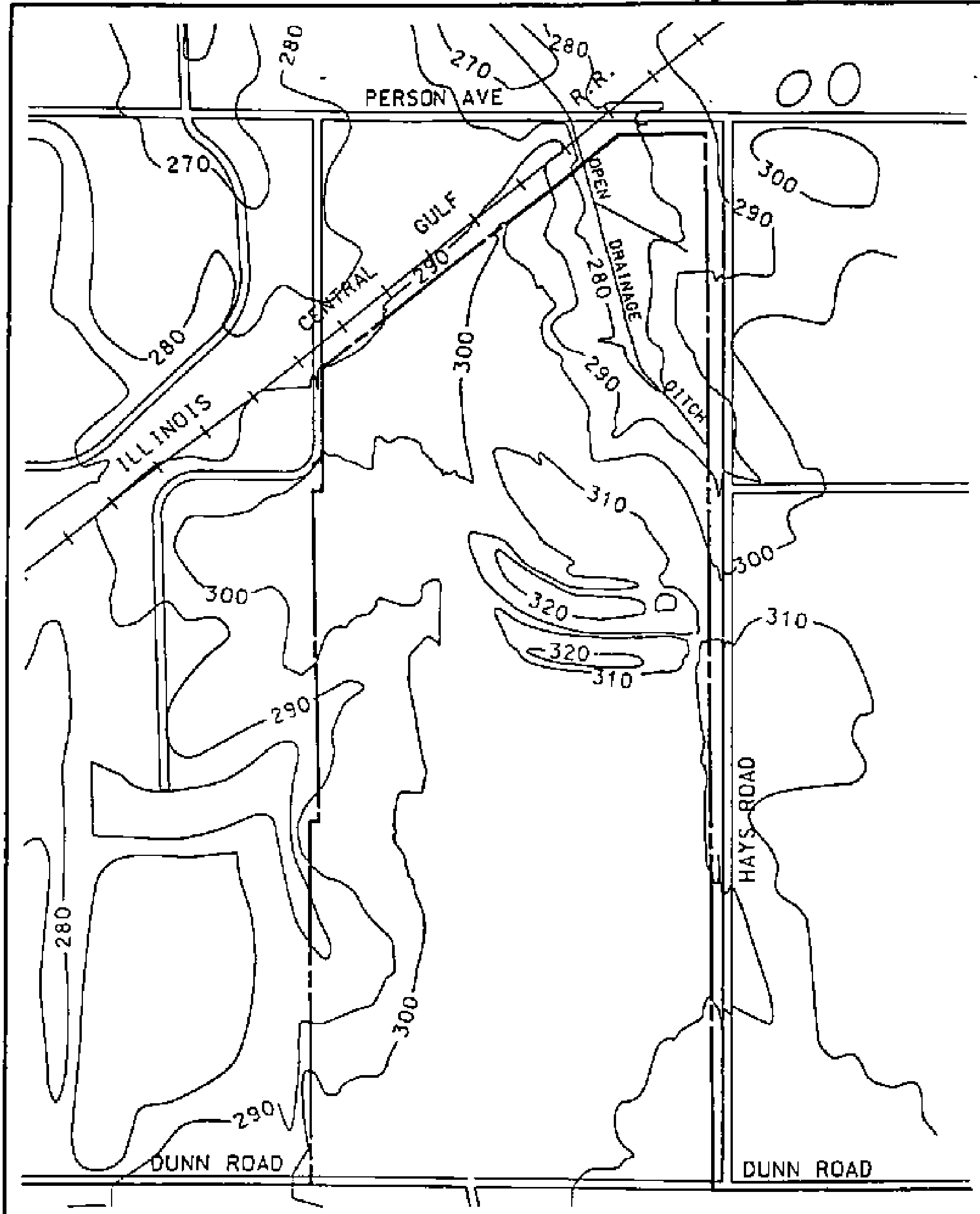

FIGURE 3.2:
TOPOGRAPHY OF
DUNN FIELD VICINITY

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The upper sand layers are orange color indicating an oxidation environment. The lower layers are very clean, tan to white sand. The sand layers become coarser downwards into the gravelly sand. Gravel size ranges from pea-sized pebbles to cobbles. The thickness of the fluvial deposit in Dunn Field ranges from 50 to 70 feet.

- Jackson Clay and Upper Claiborne Group - The Jackson Clay and the Upper Claiborne are laterally persistent and fairly uniform in thickness, approximately 80 feet, throughout Dunn Field. This unit thins markedly in the area immediately south of Dunn Field. It is a stiff gray or orange plastic, lean to fat lignitic clay. It forms a regional confining bed separating the Fluvial Deposit and the underlying Memphis Sand.

  The top of the Claiborne Formation slopes toward the northwest and west beneath most of Dunn Field with a gradient of about one percent; however, the top surface slopes southwestward beneath the extreme southern portion of Dunn Field at a rate of about 7 percent.

- Memphis Sand - The Memphis Sand of the Claiborne Group is also called the 500-foot Sand because its center occurs generally at 500-foot below ground level. This formation ranges from 500 to 900 feet in thickness. At Dunn Field, the top of the Memphis Sand is at about 180 feet below ground level along the west property line and at approximately 140 feet below ground level along the east property line. The formation is composed of thin bedded, white to brown or gray, very fine grained to gravelly, partially argillaceous and micaceous sand.

  Underneath the Memphis Sand is the Flour Island confining bed. This formation ranges from 150 to 300 feet in thickness.

3.3 Surface Water Hydrology

Due to its high relative elevation, Dunn Field receives little or no stormwater runoff from adjacent areas outside DDMT. The exposed, undisturbed surface soils in Dunn Field are primarily grassed, fine-grained semi-cohesive materials which promote runoff following storm events. Figure 3.3 presents the surface drainage boundaries at Dunn Field and shows the direction of runoff.

The majority of drainage from Dunn Field proceeds by overland flow to adjacent properties outside DDMT to the north and west. The northeast quadrant drains to the

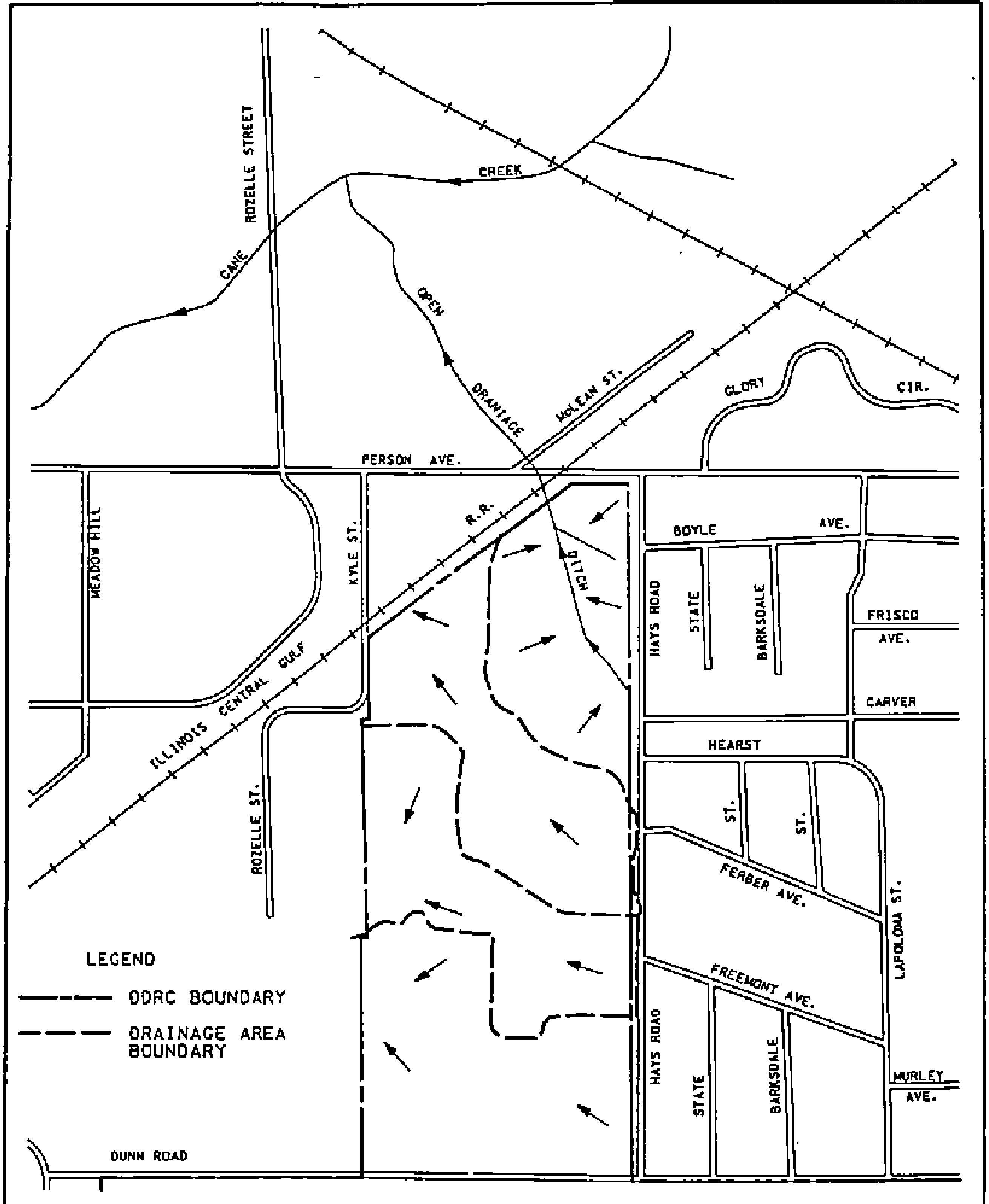

FIGURE 3.3:
SURFACE DRAINAGE
OFF DUNN FIELD

N

600 300 0 600

SCALE IN FEET

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east to either a concrete-lined, open channel or to adjacent properties to the north. The concrete-lined channel conveys stormwater from the adjacent residential neighborhood east of Hays Road through the northeast quadrant of Dunn Field. Runoff from the northwest quadrant of Dunn Field flows overland to the roadside ditch along Kyle Street. The remainder of the Dunn Field runoff flows overland to the west onto adjacent properties outside DDMT. The natural relief in the central west side of Dunn Field drains runoff into an unlined ditch which conveys stormwater east. Both the concrete-lined channel in the northeast quadrant and this unlined ditch direct flow northward to Cane Creek, a tributary of Noncannah Creek.

3.4 Ground Water Hydrology

3.4.1 Regional Hydrogeology

Water supply systems in the Memphis area depend heavily upon ground water resources. The uppermost aquifer beneath Dunn Field is the Fluvial Aquifer, which is not used in the Memphis area for drinking water because of variable water quality, high hardness, and elevated iron concentrations. Furthermore, because the loess deposits allow infiltration and recharge to the Fluvial Aquifer, this unit is susceptible to contamination from the surface.

Beneath the Fluvial Aquifer lies the Memphis Sand Aquifer, which is the shallowest artesian aquifer in the area. The Memphis Sand Aquifer is heavily used for municipal water supplies in the Memphis area, providing about 200 million gallons per day (MGD) to the City of Memphis and the surrounding unincorporated areas. The Memphis Light, Gas and Water Division operates ten wellfields in Shelby County, Tennessee, extensively using the Memphis Sand Aquifer. The closest of these wellfields to Dunn Field is the Allen wellfield, which is about 1 to 1.5 miles west of DDMT. A number of monitoring wells have been installed to characterize the Fluvial and Memphis Sand Aquifers in and around Dunn Field, Figure 3.4.

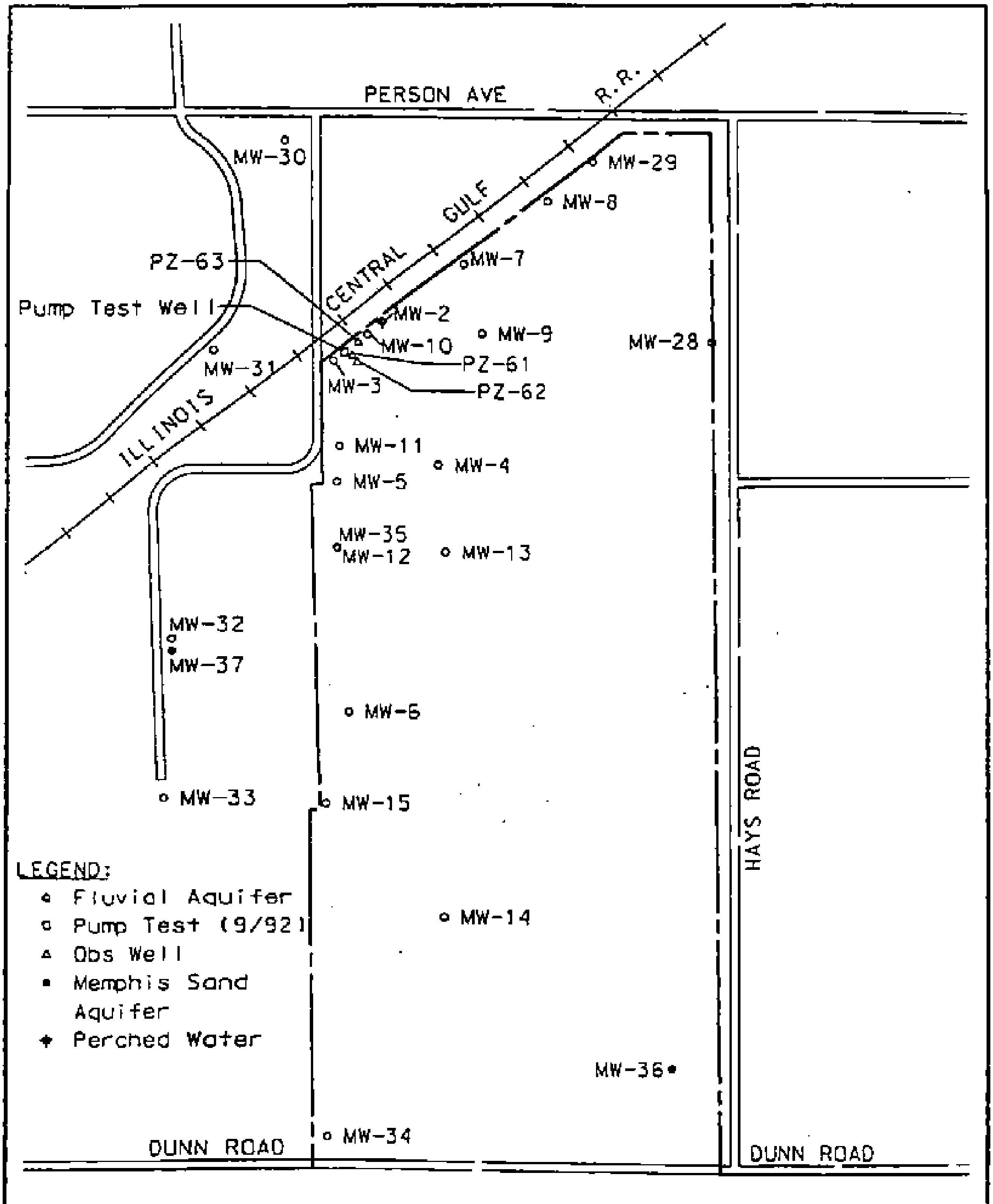

FIGURE 3.4:
EXISTING MONITORING WELLS
DUNN FIELD VICINITY

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400 200 0 400

SCALE IN FEET

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The Fort Pillow Sand Aquifer lies beneath the Memphis Sand and is not significant in this study because of its depth and because its hydraulic head is higher than the Memphis Sand stratum.

3.4.2 Site Hydrogeology

- Loess - The loess is not typically a water bearing zone. There is no evidence that it produces water to wells in the DDMT vicinity. The loess deposits permit recharge into underlying fluvial deposit during rainfall events.

  Seasonal perched ground water may occur within the loess. Monitoring well MW-2 is 30 feet deep and screened within the loess. It exhibits water at the bottom following rainfall events but dries out afterward. Water levels in adjacent wells completed in the Fluvial Aquifer are approximately 60 feet below ground level. The perched water table in northern Dunn Field is a clay-silt layer enclosed within the loess. The extent of this perched zone is not known.

- Fluvial Deposit - The fluvial deposit forms the water table aquifer in the Dunn Field vicinity. In this area, the Fluvial Aquifer is about 15 to 20 feet thick and receives recharge from rainfall infiltration through overlying loess and lateral ground water inflow from the east. Discharge is toward the Mississippi River to the west and possibly by leakage into the underlying Memphis Sand through the Jackson/Upper Claiborne confining bed.

  Based on data collected during the Law Study (Law, 1990), the Fluvial Aquifer beneath Dunn Field is moving generally toward the west (Figure 3.5). Based on data collected during the pump test, the calculated ground water flow velocity in the Fluvial Aquifer is 0.006 feet per minute. This is based on an average hydraulic conductivity of 6.91×10^{-2} feet per minute and an assumed porosity of 0.20.

- Jackson Clay/Upper Claiborne Formation - The Jackson Clay/Upper Claiborne unit is a regional confining bed which separates the Fluvial Aquifer from the Memphis Sand Aquifer. Through erosion, this unit is thinned at DDMT immediately south of Dunn Field. It is documented (1989 Smith and Ishak/Muhamad) that some areas of the Memphis Sand are directly overlain by the fluvial deposit. No interconnections have been found between the Memphis Sand and the Fluvial Aquifer in the DDMT vicinity.

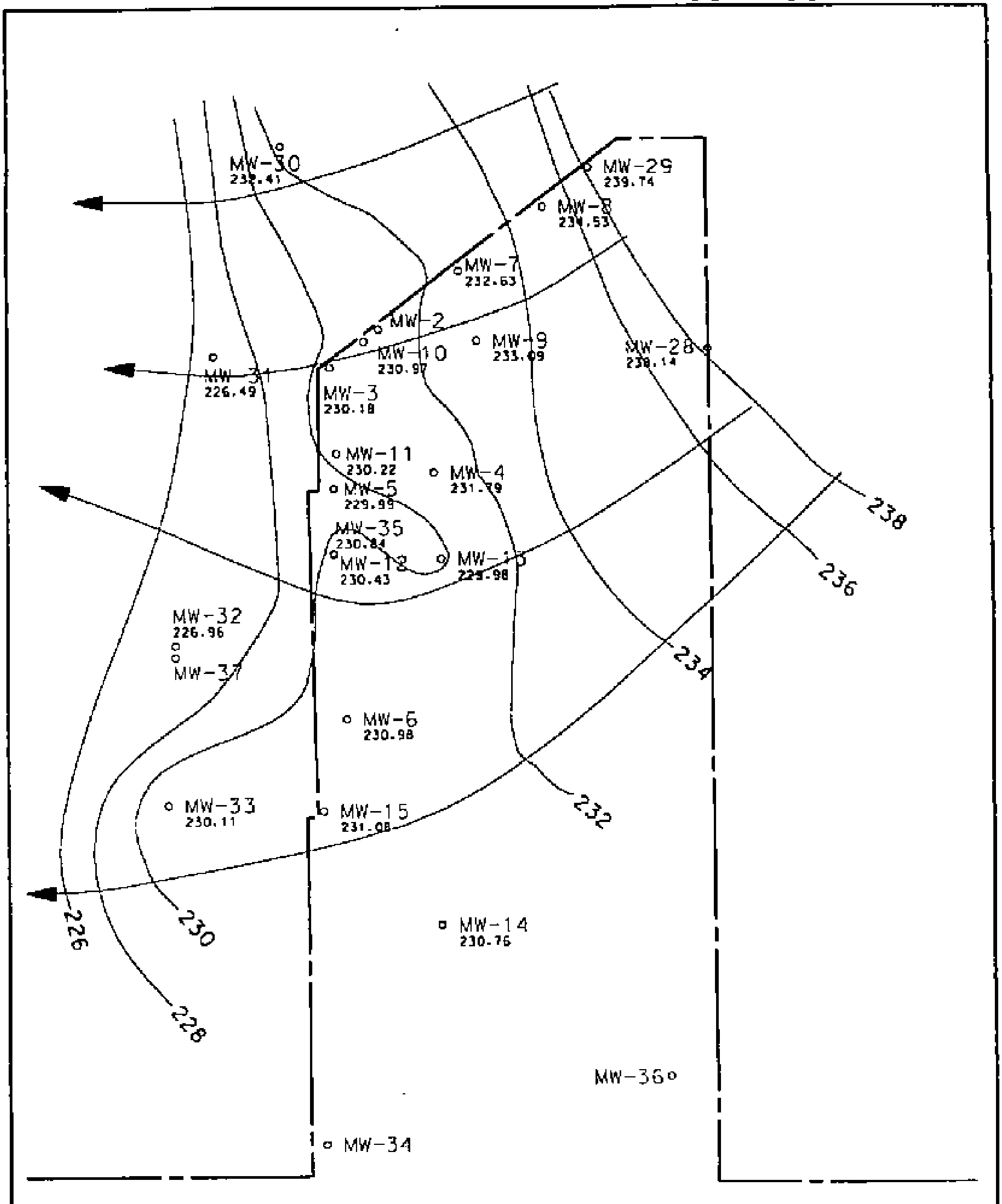

FIGURE 3.5
GROUND WATER FLOW PATTERNS
IN THE FLUVIAL AQUIFER
DUNN FIELD VICINITY
SEPTEMBER, 1992

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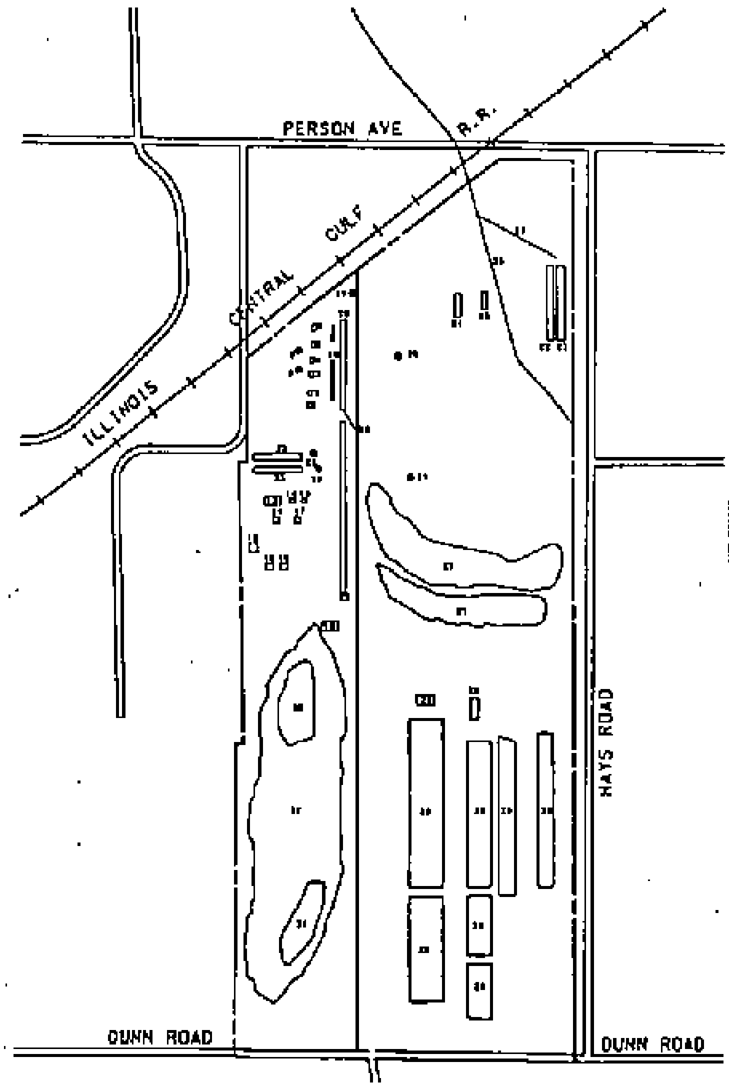
- December 1989 measurements of MW-32 (Fluvial Aquifer) and MW-37 (Memphis Sand Aquifer) indicated that the water elevation of the Fluvial Aquifer was at 226 feet above Mean Sea Level (MSL), compared to the water level in the Memphis Sand of 143 feet MSL. The hydraulic head difference is about 83 feet.

- Memphis Sand - The top of Memphis Sand is approximately 125 to 150 feet above MSL in the vicinity of DDMT. The base of this unit is about -750 feet MSL. Thus, the aquifer is about 900 feet thick and is under confined conditions. Recharge to the aquifer occurs from rainfall infiltration on the outcrop located to the east of the site and possibly from leakage from the overlying Fluvial Aquifer. The Memphis Light, Gas and Water Division (MLGW) operates eight well fields which extract water from the Memphis Sand for municipal supply. The Allen wellfield, located 1 to 2 miles to the west of DDMT, is one of these fields. Water levels in the two Memphis Sand wells installed during the Law Study (1990 Law) suggest a gradient toward the west.

3.5 Summary of Previous Investigations

A variety of environmental and industrial hygiene studies have been conducted at DDMT over the past two decades, as described in Section 4.0 of Volume I of the Law Work Plan (1989 Law). An installation assessment of hazardous materials practices was prepared to assess potential sources of contamination (1981 USATHAMA). The burial sites at Dunn Field were identified (see Figure 3.6) and categorized as having the greatest potential for off site migration. As a result of this study, a geohydrologic evaluation was conducted (1982 AEHA). Seven wells were installed in the northwest quadrant of Dunn Field to determine ground water quality and ground water elevations. Ground water from six of the wells were sampled and analyzed for inorganic compounds including fluoride, chloride, phenol and metals. The results did not reflect any serious ground water contamination from the disposal operations in Dunn Field. No samples were analyzed for volatile organic compounds.



Dunn Field Disposal & Storage Sites

LOCATION	
BURIAL SITES	
1	TRAINING SETS, NINE EACH, MUSTARD AND LEWISITE, 1955.
2	7 POUNDS (LBS) AMMONIUM HYDROXIDE, 1 GAL GLACIAL ACETIC ACID, 1955.
3	3,000 QUARTS (QT) CHEMICALS 5 CUBIC FEET (FT(3)) ORTHO-TOLIDINE DIHYDROCHLORIDE, 1955.
4	THIRTEEN 55-GAL DRUMS OIL, GREASE, AND PAINT, DATE UNKNOWN.
5	THIRTY-TWO 55-GAL DRUMS OIL, GREASE, AND THINNER, 1955.
6	3 FT(3) METHYL BROMIDE, 1955.
7	40,037 UNITS OINTMENT (EYE), 1955.
8	1,700 BOTTLES FUMING NITRIC ACID, 1954.
9	3,768 1-GAL CANS METHYL BROMIDE, 1954.
10	ASHES AND METAL REFUSE FROM BURNING PIT, 1955.
11	1,433 1-OUNCE 9020 BOTTLES TRICHLOROACETIC ACID, 1965.
12	SULPHURIC/HYDROCHLORIC ACIDS, 1967.
13	32 CUBIC YARDS MIXED CHEMICALS AND ACID, 900 LBS DETERGENT, 7,000 LBS ALUMINUM SULPHATE, 200 LBS SODIUM.
14	SODIUM, 1968.
15	SODIUM PHOSPHATE, 1968.
16	ACID, 1969.
17	HERBICIDE, CLEANING COMPOUND, MEDICAL SUPPLIES, 1969.
18	ACID, DATE UNKNOWN.
19	HARDWARE (NUTS AND BOLTS)
22	XXCC3 IMPREGNITE.
29	FOOD SUPPLIES.
30	BURIAL SITE PRIOR TO BAUXITE STORAGE FOODS, CONSTRUCTION DEBRIS BURNED, 1948.
33	14 BURIAL PITS CONTAINING SODIUM PHOSPHATE, SODIUM, ACID, MEDICAL SUPPLIES, CHLORINATED LIME, 1970.
BURN SITES	
21	SANITARY WASTE, SMOKE POTS, CN CANISTERS.
31	OLD BURN AREA, 1946.
STORAGE SITES	
25	PESTICIDE STORAGE
27	BAUXITE
28	FLUORSPAR
32	BAUXITE, 1942-72.
OTHER SITES	
20	ASPHALT DUMP
23	OPEN DRAIN DITCHES
24	PISTOL RANGE
26	BURIED DRAINPIPE

400 200 0 400

SCALE IN FEET

FIGURE 3.6: DUNN FIELD DISPOSAL & STORAGE SITES

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A RCRA Facility Assessment (RFA) was performed in 1989 which identified Solid Waste Management Units, SWMU, and Areas of Concern, AOC (1990 A.T. Kearney). The purpose of the RFA was to assess the release potential of hazardous constituents from these units. Further investigatory sampling and analysis were recommended for the SWMUs identified in Dunn Field.

An initial investigation was performed in 1989 and 1990 to identify soil and groundwater contamination (1989 Law). The report from this investigation is hereinafter referenced as the "Law Study" (1990a and 1990b Law).

During the Law Study, volatile organic compounds (VOCs) and metals were found in ground water beneath Dunn Field at levels exceeding the federal primary drinking water standards. Ground water samples were analyzed for the 129 priority pollutants excluding asbestos and cyanide.

- Volatile Organic Compounds - Eleven volatile organic compounds were detected in the Fluvial Aquifer. The plumes of tetrachloroethene; 1,1,2,2-tetrachlorothane; and 1,1-dichloroethene were illustrated in Figure 4-4 of the Law Study, page 3-14 of this chapter. Due to ground water flow and past hazardous waste disposal site locations, the plumes appear aligned with the north and west property lines. Well MW-30 is the northern boundary and MW-33 is the southern boundary of the plumes. The western boundary of these plumes has not been delineated.

  A trichoroethene (TCE) plume was found at the highest concentrations of all the VOCs detected at Dunn Field. TCE was about 2 ug/L at MW-15 and 1,500 ug/L at MW-12 during the Phase I of the LAw Study (April 1989). TCE was about the same concentration at MW-15 during Phase II of the Law Study (January 1990) but had increased to 5,100 ug/L in MW-12.

- Metals - Figure 4-5 of the Law Study, shown on page 3-15 of this chapter, presents the concentration contour maps for chromium and lead. These plumes cover a wider area than the organic plumes, possibly because the releases of metals occurred first. However, metals were also found in the background well (MW-16) during the Law Study. This well is located in the northeast corner of the main installation, and has water levels that are upgradient of the entire installation. This well exhibited chromium at 50 to

FIGURE 4-4

VOLATILE ORGANICS CONTAMINATION EXTENT IN FLUVIAL AQUIFER

DEFENSE DEPOT, MEMPHIS TENNESSEE

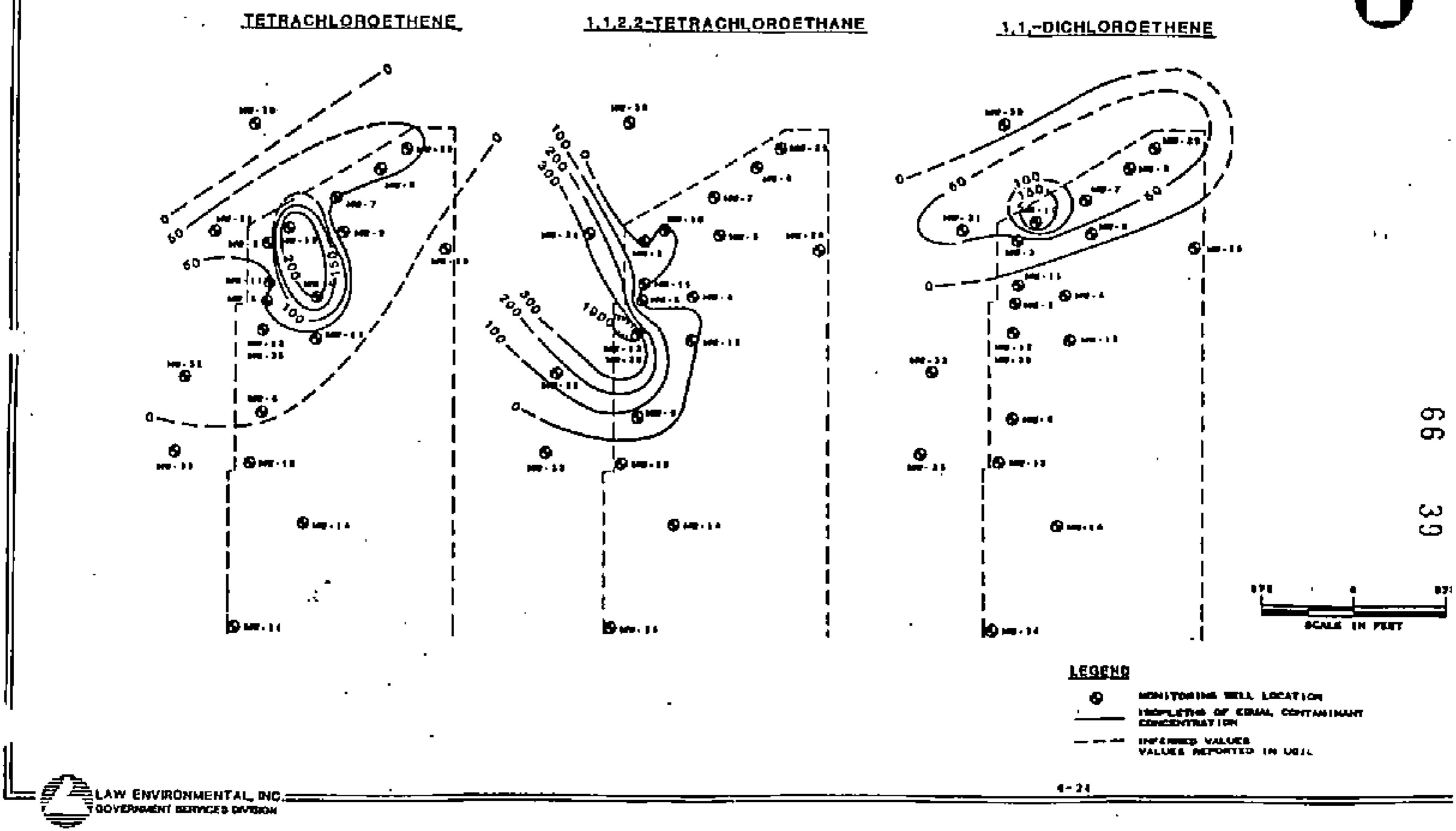

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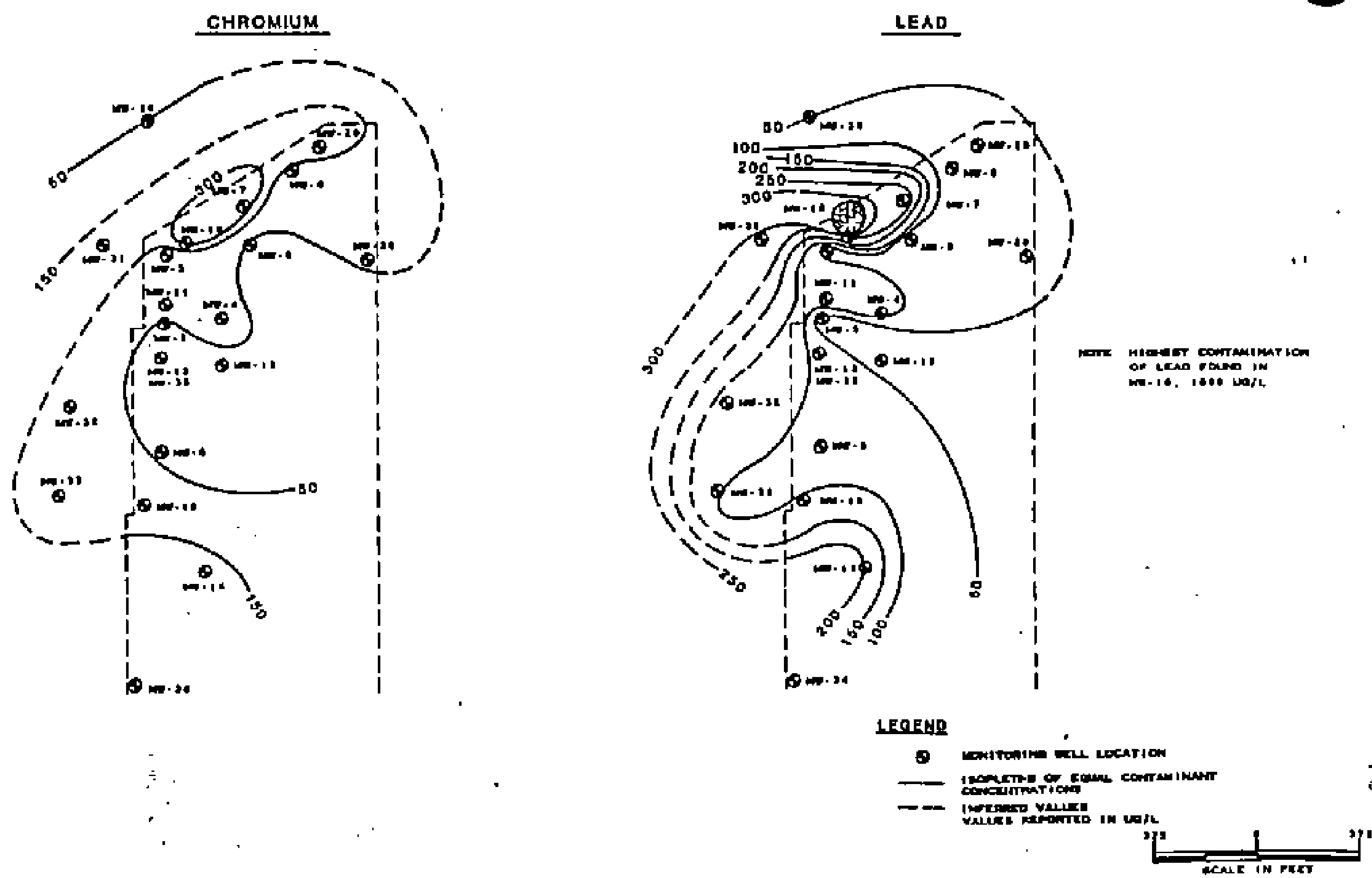
FIGURE 4-5
EXTENT OF ELEVATED METALS IN FLUVIAL AQUIFER
DUNN FIELD
DEFENSE DEPOT, MEMPHIS TENNESSEE



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LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

55 ug/L, lead at 80 ug/L, and nickel at 29 to 40 ug/L during the Law Study (1990 Law). The lead concentration exceeds the federal MCLs, and the nickel exceeds the State of Tennessee criterion. Lead exceeds the U.S. EPA action level of 15 ug/L. These metals were not found above action levels in follow-up sampling in 1993.

- Memphis Sand Aquifer - Two wells from the Law Study are installed in the Memphis Sand. MW-36 is located at the southeast corner of Dunn Field and can be considered as an upgradient well. MW-37 is located west of Dunn Field (Figure 3.4) and is a downgradient well. These wells exhibited only low levels of metals. Acetone was detected in the water sample from MW-37 at a concentration of 3,500 ug/L.

  Three wells (126, 127, and 128) of the Allen Well Field were closed due to VOCs contamination. The Memphis Light, Gas and Water Division is investigating the cause of the contamination but the source has not been identified. Other Allen Well Field wells located between these three wells and DDMT do not exhibit VOC contamination.

The Law Study concluded that the plume of contaminated ground water had migrated in a generally west and northwest direction. The source was believed to be from the waste material burial trenches in the northwest quadrant of Dunn Field. The western extent of the plume was not defined. Additional investigations were recommended to more fully delineate the plume and to better characterize the Fluvial Aquifer so that an effective remedial measure could be designed. In 1992, DDMT was placed on the National Priorities List (NPL) (57 FR 47180, October 14, 1992).

Engineering-Science, Inc. (ES) was retained in 1991 to perform a pumping test of the Fluvial Aquifer, conduct a follow-on RI/FS to fill data gaps left by the Law Study, and recommend and design an Interim Remedial Measure (IRM) system for Dunn Field. The pumping test was conducted in September 1992. A pumping test well and three piezometers were installed in the northwest corner of Dunn Field. The Fluvial Aquifer was found to be relatively isotropic. The data generated from this test was used to estimate the following parameters (1992 ES):

transmissivity	1.385 ft^2/min
hydraulic conductivity	6.91 x 10^{-2} ft/min
specific yield	0.19
specific capacity	5.84 gpm/ft
well efficiency	83%
well yield	75 gpm
radius of influence	420 ft

Ground water extracted during the pumping test was sampled at beginning, midpoint, and end of the 42-hour long, constant-discharge test. The extracted ground water was filtered to remove particulates, treated with activated carbon to remove VOCs and then stored. Samples were collected from the treated water. All water samples were analyzed for volatile organic compounds, semivolatile organic compounds (including chloroacetophenone), pesticides, PCBs, selected metals, agent mustard, and thiodiglycol. Further discussion of these results is presented in Section 4.3 of this report.

4.0 PRELIMINARY RISK ASSESSMENT

Ground water contaminants beneath Dunn Field create a potential threat to human health and the environment in the absence of a remedial measure. The risk assessment at Dunn Field incorporates data identifying the extent, nature, and potential transport of contaminants with potential ground water exposure pathways and receptors in order to characterize potential human or environmental risks associated with the site. This risk assessment is intended to address only ground water pathways in the Dunn Field area of DDMT. A baseline risk assessment for the entire facility was included in the Law Study (1990 Law) which evaluated risks associated with soil, air and water.

4.1 Identification of Receptors

The potential human receptors for the facility include the residents of Memphis, and the employees and neighbors of DDMT.

The city of Memphis is approximately 300 square miles in size and had a 1990 population of 610,337 people. Although the city is experiencing a 5.3 percent negative annual population growth, it still remains the largest city in Tennessee. The three largest industries in the Memphis Metropolitan Statistical Area are as follows: 1) the wholesale and retail industry, which employs approximately 125,600 persons; 2) the service industry, which employs approximately 120,200; and 3) the government, which includes federal, state and city, which employs approximately 75,700 people. The average per capita and household income in Memphis is estimated to be $12,593 and $33,432 respectively.

There are eight permanent residences located within DDMT boundaries. These residences are located in the southeastern quadrant of the facility. The average number of residents living at DDMT at any one time is about twenty-five people.

4.2 Identification of Exposure Pathways

An exposure pathway is a route for contaminated material to reach a receptor. This pathway must have a source of contamination, a transport medium and an exposure point. The exposure pathway for the potentially contaminated ground water at Dunn Field is discussed below.

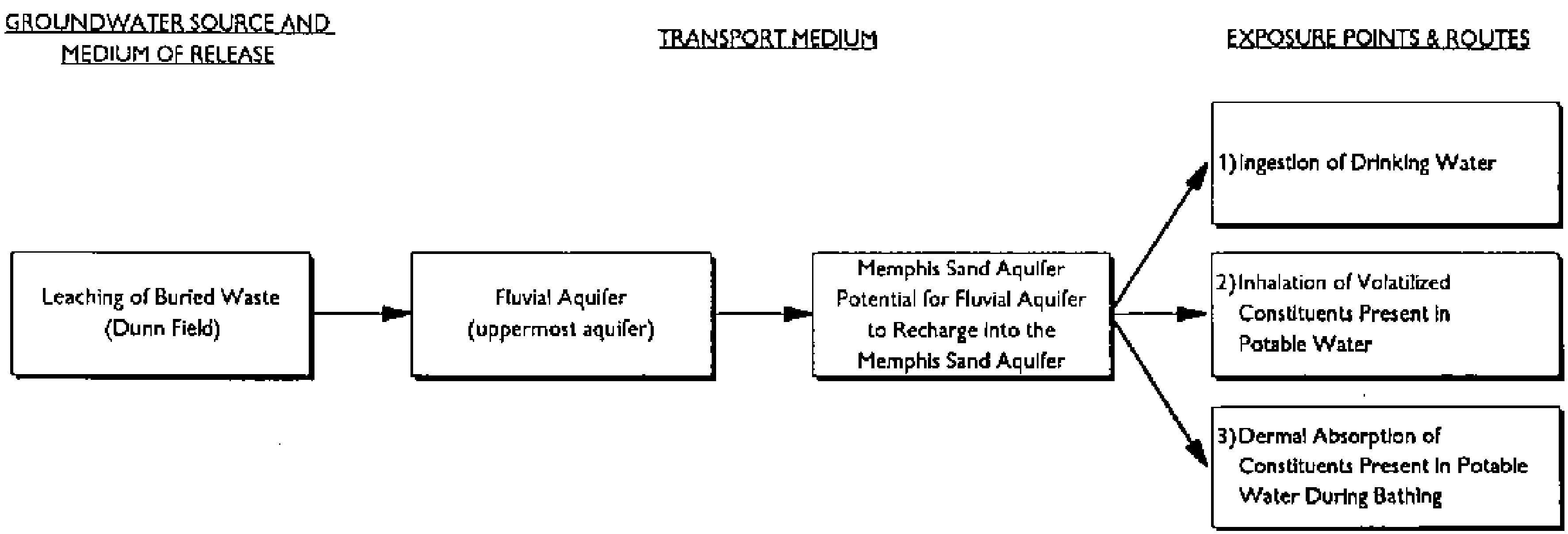
The primary source of ground water contamination in Dunn Field is believed to be from waste materials buried in unlined trenches. The transporting mechanism is rain water infiltrating through these buried wastes into the underlying soils. Some contaminants such as volatile organic compounds (VOCs) and metals, are leached from the wastes, transported downward through the soil, and introduced into the upper-most aquifer beneath Dunn Field. This aquifer, known as the Fluvial Aquifer, is separated from the Memphis Sand Aquifer by a clay layer. There is potential for the Fluvial Aquifer to recharge into the Memphis Sand Aquifer, which serves as the public water supply in the Memphis metropolitan area. The potential exposure points and routes of exposure for ground water constituents include the following:

1. Ingestion of ground water (Memphis Sand aquifer only)
2. Skin contact with potentially contaminated potable water during bathing and
3. Inhalation of vapors from volatile organic compounds present in potable water, which are emitted during household use.

Figure 4.1 presents this potential ground water exposure pathway for the contaminants in Dunn Field.

FIGURE 4.1

POTENTIAL GROUNDWATER EXPOSURE PATHWAY FOR CONTAMINANTS IN DUNN FIELD



Based on USEPA Guidance for Conducting RI/FS under CERCLA, October, 1988

Constituents of concern were identified in Dunn Field monitoring wells screened in the Fluvial Aquifer. These constituents include the following compounds or elements:

<u>Volatile Organic Compounds</u>
- 1,1 dichloroethene
- 1,2 dichloroethene (total)
- 1,1,2,2 tetrachloroethane
- tetrachloroethene
- trichloroethene
- carbon tetrachloride

Constituents of concern in the Fluvial Aquifer have not been detected in Memphis Sand ground water samples (MW-36 and 37). However these constituents were present in some soil borings (1990 Law). One VOC, acetone, was found in MW-37 during the second phase of the 1990 Law Study, but this observation has not been confirmed by a second sample. Acetone is a common laboratory contaminant, which is the potential source of the 1990 observation. Acetone was not found in any consistent pattern in the overlying Fluvial aquifer during the Law Study, which strongly suggests that Dunn Field was not the source of acetone in MW-37. Nonetheless, leakage of VOCs through the confining unit into the Memphis Sand Aquifer can potentially occur in areas not yet identified.

4.3 Comparison of Concentrations to Standards

The U.S. EPA has established Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) for a number of chemicals. The State of Tennessee has adopted guidelines which are equivalent to the federal guidelines (Appendix A). By definition, the MCLGs are nonenforceable goals while the MCLs are enforceable standards which must be set as close to the MCLGs as feasible. The MCLs combine health effects information on specific constituents with other inputs on exposure, methods for chemical analysis, methods of treatment, economics, etc. The total human exposure to specific contaminants is considered in developing the MCL, which attempts to set lifetime limits at the lowest practical level to minimize the amount of toxicity contributed by drinking water. A daily intake of two liters of water is assumed in developing these regulations (Dec. 1989 U.S. EPA).

The constituents of concern found in the Fluvial Aquifer beneath Dunn Field occur at concentrations above the MCLs or MCLGs (Table 4.1). The comparison was made for data collected during Phase I of the Law Study (1989), Phase II of the Law Study (1990) and the Pump Test conducted in Dunn Field in 1992. Table 4.1 summarizes this data for both VOCs. Highlights of this data are discussed below.

Trichloroethene was detected above the MCL of 5 micrograms per liter (ug/L) in samples collected from 1989, 1990 and 1992. Trichloroethene was found as high as 5,100 ug/L during the Law Study at MW-12 (1,020 times the MCL). In 1992, the samples collected from the PTW exhibited as much as 360 ug/L of trichloethene (72 times the MCL).

The MCL for tetrachloroethene is 5 ug/L. Tetrachloroethene was detected as high as 240 ug/L in MW-10 in 1990 (48 times the MCL). In 1992, the pump test well exhibited as much as 100 ug/L (20 times the MCL).

The VOC 1,1-dichloroethene, which has an MCL of 7 ug/L, was detected in MW-10 at 160 ug/L in 1990 (23 times the MCL). In 1992, the PTW exhibited as much as 50 ug/L of 1,1-dichloroethene (7.1 times the MCL).

4.4 Frequency of Detection of Chemicals of Concern

During the Law Study in 1989 and 1990, ground water samples were collected from 17 monitoring wells in Dunn Field. Volatile organic compounds (VOCs) were detected in the ground water at levels exceeding the MCLs and the State of Tennessee guidelines. During the pumping test conducted in 1992, three ground water samples were collected from the pump test well location. During the pump test, the same VOCs were detected at levels exceeding the federal MCLs.

TABLE 4.1

Comparison of Constituents to Standards in Dunn Field Ground Water

Constituent	MCL (ug/L)	RI Phase I Highest Levels 1989 (ug/L)	RI Phase II Highest Levels 1990 (ug/L)	Pump Test Highest Levels 1992 PTW (ug/L)
<u>Volatile Organic Compounds</u>				
1,1 dichloroethene	7	130 (MW-10)	160 (MW-10)	50
1,2 dichloroethene	100/70[1]	520[2] (MW-11)	510[2] (MW-12)	220
tetrachloroethene	5	210 (MW-5)	240[2] (MW-10)	100
trichloroethene	5	1,700[2] (MW-12)	5,100[2] (MW-12)	360
carbon tetrachloride	5	77 (MW-6)	40 (MW-6)	ND

Source: ES, 1994.

Notes:
1 - Trans isomer / Cis isomer
2 - identified in the analysis from a secondary dilution factor.

Abbreviations:
ug/L - micrograms per liter
ND - Not detected
MW - Monitoring Well
PTW - Pump Test Well

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The frequency that VOCs exceeded the MCLs was compiled to illustrate the spatial extent and persistence of these constituents (Table 4.2). This analysis considered ground water samples analyzed during the Phase I of the Law Study (March and April 1989) and Phase II (January 1990) and the pumping test (September 1992). Table 4.2 lists the VOCs that were detected and their corresponding MCLs. The range of detection for each constituent identifies the lowest and highest concentration detected during analysis. In all cases the ranges span from below the detection limits to above the MCLs. The detection limits all fell below MCL concentrations. During the Law Study (1990 Law), 17 sites were tested and one site was tested during the pumping test (1992) for a total of 18 sites. The number of ground water sampling sites with contaminant detections above the MCLs is compared to the total number of ground water sampling sites in the study. A total of 35 analyses have been performed on these 18 sites between 1989 and 1992. The number of samples with contaminant levels above the MCLs is compared to the total number of samples analyzed.

The most frequently detected volatile organic compound found above the MCL was trichloroethene (MCL is 5 ug/L). Trichloroethene was identified in 14 out of 18 sites. The detection limits ranged from less than the detection limit to 5,100 ug/L. Levels of trichloroethene above the MCLs were detected in 22 samples out of a total of 35 samples.

Tetrachloroethene (MCL 5 ug/L) was detected above the MCLs in 12 sites out of 18. Concentrations in the samples ranged from less than the detection limits to 240 ug/L. Levels of tetrachloroethene above the MCLs were detected in 19 out of 35 samples.

TABLE 4.2

Frequency of Detection Above Maximum Contaminant Levels (MCLs)
1989, 1990, and 1992

Metal Constituents	MCL (ug/L)	Range <DL->MCL (ug/L)	Sites Greater than the MCL (Sites/Total Sites)	Samples Greater than the MCL (Samples/Total Samples)
Volatile Organic Compounds				
1,1-dichlorethene	7	<DL-160	6/18	10/35
1,2-dichloroethene (total)	70	<DL-520[1]	5/18	7/35
trichloroethene	5	<DL-5100[1]	14/18	22/35
tetrachlorethene	5	<DL-240[1]	12/18	19/35

Source: (1990 Law) and (1992 ES)

Notes:
1 - identified in an analysis at a secondary dilution factor
<DL - less than the Detection Limits (Detection limits were less than the MCL)
>MCL - greater than the Maximum Contaminant Level
ug/L - micrograms per liter

4.5 Risk Evaluation and Summary

An assessment of Dunn Field reveals a large number of constituents present in the ground water. The most frequently detected VOCs above the MCLs were trichloroethene and tetrachloroethene. Chromium and lead were the metals most frequently detected above the MCLs in 1989 and 1990, but were below MCLs in 1992.

A potential public health risk is associated with the Fluvial Aquifer. This aquifer contains VOCs which could negatively impact the Memphis Sand Aquifer, the potable drinking source for 610,000 people. Further investigation is needed to establish the extent of ground water contamination at and near Dunn Field. Nevertheless, leakage through the confining unit into the Memphis Sand Aquifer can potentially occur in areas not yet identified.

5.0 REMEDIAL RESPONSE OBJECTIVES AND CRITERIA

The remedial response objectives at Dunn Field have been established, based on the nature and extent of the contamination, the receptors that are potentially threatened, and the potential for human and environmental exposures. The following is a list of response objectives for ground water at Dunn Field:

1. Prevent exposure to currently contaminated ground water (Fluvial Aquifer),
2. Protect the lower aquifer (Memphis Sand) from contamination,
3. Reduce contaminant migration from beneath Dunn Field to off-site areas,
4. Satisfy the on-going requirements of the DDMT's RCRA Permit.

Response objectives are formulated based on the goal of the Superfund program to protect public health and the environment by either (1) restoring potentially usable contaminated ground water to levels that are safe for present and potential users and/or environmental receptors, or (2) preventing exposure to ground water contaminated above health-based levels. The preference of the Superfund program is to restore and protect usable ground water. The following sections discuss the objectives and criteria for an interim remedial measure at Dunn Field.

5.1 Applicable or Relevant and Appropriate Requirements

Section 121 (d) of CERCLA requires the selection of a remedial action that is protective of human health and the environment. The U.S. Environmental Protection Agency's (USEPA) approach to determining protectiveness involves a two tiered approach: 1) protectiveness based on Applicable or Relevant and Appropriate Requirements (ARARs) and 2) protectiveness using risk calculations that develop concentration limits based on the carcinogenic or non-carcinogenic effects of specific chemicals under given exposure conditions.

An ARAR represents a minimum standard or an action level/cleanup value that a remedy must attain. When ARARs do not exist or are questionable, risk-based calculations should be developed in accordance with the USEPA guidance document *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual*, December 1989, EPA 540/1-89/002. The calculated value(s) will then represent the action level for the contaminant(s) of concern.

5.1.1 Types of ARARs

The USEPA has grouped ARARs into Chemical-Specific, Action-Specific, and Location-Specific classifications. These three classifications are defined below:

- Chemical-Specific ARARs are usually health or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

- Action-Specific ARARs are usually technology or activity-based requirements or limitations on actions taken with respect to hazardous wastes.

- Location-Specific ARARs are restrictions placed on the concentration of hazardous substances or the performance of activities solely because they occur in special locations.

The following sections present a list of the Chemical-Specific, Action-Specific, and Location-Specific ARARs that apply to Dunn Field.

Chemical-Specific ARARs/Ground Water Media

For cleaning up ground water that may be used for drinking, 40 CFR Section 300.430 of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) states that maximum contaminant level goals (MCLGs), established under the Safe Drinking Water Act, that are set at concentrations above zero shall be attained if relevant and appropriate to the circumstances of the release. Where the MCLGs for a contaminant has been set at a concentration of zero, the Maximum Contaminant Levels (MCL) promulgated for that contaminant under the Safe Drinking Water Act shall be attained. MCLGs and MCLs are relevant and appropriate as cleanup levels for ground water that is a current or potential source of drinking water. If a MCLG or MCL value has not been developed for the contaminant(s) of concern, then the ground water standards promulgated under the Resource Conservation and Recovery Act (RCRA) 40 CFR 264.94 shall be attained if relevant and appropriate to the circumstances of the release. The only exception to the approach described above is that the cleanup value for lead in ground water used for drinking is not its MCL. In an USEPA memorandum dated 21 June 1990, from Henry Longest, Director of the Office of Enforcement and Remedial Response (OERR) to Patrick Tobin, Director of Waste Management Division Region IV, Mr. Longest recommended a final action level for lead of 15 parts per billion. The MCLs and the MCLGs for the potential contaminants of concern were presented in Tables 4.1 and 4.2 in Chapter 4.0.

Action-Specific ARARs/Ground Water Media

The remediation of ground water using pumping and treatment techniques would require the discharge of the treated water to surface waters or to a Publicly Owned Treatment Works (POTW) or into the same formation from which it was withdrawn.

Both on-site and off-site discharges from CERCLA sites to surface waters are required to meet the substantive requirements of the National Pollutant Discharge Elimination System Program (NPDES). These substantive requirements include discharge limitations (both technology and water quality based), certain monitoring requirements, and best management practices. These requirements will be contained in an NPDES permit for off-site discharges. For an on-site discharge from a CERCLA site, these substantive requirements must be identified and complied with if the discharge passes off-site. If the preferred alternative involves only an on-site, direct discharge, only substantive NPDES requirements would apply to the action.

The discharge of CERCLA wastewater to POTWs is considered an off-site activity. Therefore, CERCLA responses are required to comply with all applicable (both substantive and administrative) requirements of the national pretreatment program, including the general and specific discharge prohibitions. Further, all local pretreatment regulations must be complied with before discharging wastewater to a POTW.

The operation and construction of Class IV wells, as defined in the Underground Injection Control (UIC) Program is prohibited, unless the wells are used to reinject treated ground water into the same formation from which it was withdrawn as part of a CERCLA cleanup or a RCRA corrective action (40 CFR 144.13(d)). The UIC program defines Class IV wells as those used to inject hazardous waste or radioactive waste into or above a formation, that within one-quarter (1/4) mile of the well, contains an underground drinking water source.

Underground injection wells that are constructed off-site are subject to all provisions of the Safe Drinking Water Act relating to underground injection of fluids and must be permitted by an authorized state agency or EPA and comply with the UIC permit requirements. Superfund sites that construct underground injection wells on-site are not required to comply with the administrative requirements of the UIC program, however, they must meet the substantive requirements of this program where the requirement is determined to be applicable or relevant and appropriate to the CERCLA remedial action.

Location-Specific ARARS/Ground Water Media

The Memphis-Shelby County Groundwater Quality Control Board prohibits the operation of injection wells which introduce ground water or chemically or thermally altered water into underground formations. A variance to this regulation would be required to allow reinjection of treated water from the Fluvial Aquifer if this disposal strategy is selected at Dunn Field.

Chemical-Specific ARARS/Air Media

The VOCs that are contaminants of concern in the ground water beneath Dunn Field can react with sunlight and contribute to the formation of ozone in the lower levels of the atmosphere. These type of compounds are known as ozone precursors. Memphis-Shelby County is a non-attainment area for ozone, since ozone has been periodically found above federal guidelines for ambient air. Ozone is regulated under the Clean Air Act (CAA) in accordance with the National Ambient Air Quality Standards (NAAQS). EPA is currently reviewing an application to redesignate Memphis-Shelby County as an attainment area for ozone. Air program requirements that are a part of the State Implementation Plan (SIP) under the CAA are considered potential ARARS. The Memphis-Shelby County Air Pollution Control Guidelines are specified in Section 1200-3-18-.02 (see Appendix B).

The use of air stripping techniques to remove VOCs from ground water will cause the on-site emission of VOCs into the atmosphere. Under CERCLA and in accordance with OSWER Directive 9355.7-03 (Appendix G), this on-site emission is required to meet only the substantive requirements of state and local authorities. Requirements related to attainment of NAAQS are ARARS only when the remedial activity at a CERCLA site is a "major" source of emissions. A CERCLA site in Memphis-Shelby County would not be considered a "major" source unless its emissions exceeded 100 tons per year of ozone precursors in a non-attainment area for ozone. If Memphis-Shelby County were designated an attainment area for ozone, a CERCLA site would not be considered a major source unless it emitted more than 250 tons per year (August 1989 U.S. EPA).

Hazardous air pollutants are regulated under the Clean Air Act in accordance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs). Discussions with Memphis Shelby County Air Pollution Control have indicated that the State of Tennessee Air Pollution Code Section 16-81 Reference 1200-3-11 for the emission of

Toxic Air Pollutants has been adopted by Memphis-Shelby County. The toxic air pollutants referenced are potential chemical specific ARARs (Appendix A).

The toxic air pollutants that are referenced in the Code are substances that have not been identified in the ground water at Dunn Field. Therefore, the remediation of ground water by pumping and treatment technology would not generate emissions of the Toxic Air Pollutants regulated under the CAA in accordance with the NESHAPs.

Location-Specific ARARs/Air Media

The Memphis/Shelby County Health Department has adopted the State of Tennessee Air Code. Ozone, carbon monoxide and lead air pollutants for Memphis/Shelby County has been designated a nonattainment area by EPA Region IV. EPA is currently reviewing applications (carbon monoxide application was submitted in October 1992, ozone application was submitted in November 1992) to redesignate Memphis-Shelby County as an attainment area for ozone and carbon monoxide. The initial information was documented in a letter dated 5 February 1991 sent by the Regional Administrator, Greer C. Tidwell, EPA Region IV to the Governor of Tennessee, Ned McWherter. A copy of this letter is presented in Appendix C.

Action-Specific ARARs/ Air Media

There are no current activity-based air requirements or limitations for air stripper technology or UV/oxidation technology with respect to air constituents. Under the New Source Performance Standards of the CAA, selected action-specific ARARs have been determined only for incineration technology, statutory gas turbines and storage of petroleum liquids (August 1989 U.S. EPA).

Location-Specific ARARS/Natural Resources

Preliminary discussions with the Tennessee Department of Conservation, Division of Solid Waste Management, has indicated that the state is not aware of any natural resources for which they act as a trustee which are potentially threatened or damaged as a result of past waste disposal practices in Dunn Field. Furthermore, the Law Study (1990 Law) stated that no federal natural resources are located near the site. However, this will need to be confirmed with the U.S. Department of the Interior.

5.2 Ground Water Cleanup Goals

Water supply systems in the Memphis area depend heavily on ground water resources. The uppermost aquifer beneath Dunn Field is the Fluvial Aquifer. During the Law Study (1990 Law), VOCs were detected in the Fluvial Aquifer beneath Dunn Field at levels exceeding the federal drinking water standards. The same VOCs were present in the pump test well (fluvial aquifer) at levels above federal standards (1992 ES). However, metals observed above federal standards in 1990 were found at much lower concentrations in the 1992 pump test.

Beneath the Fluvial Aquifer lies the Memphis Sand Aquifer, which is heavily used for municipal water supplies. This aquifer provides about 200 million gallons per day to Memphis and the surrounding unincorporated area. Two monitoring wells at DDMT extend into the Memphis Sand, and with the exception on acetone (which is not a constituent of concern), did not exhibit VOC contamination.

In response to chemical and action-specific ARARS in Dunn Field, the technologies which could be used to mitigate ground water must meet the substantive requirements. Groundwater Cleanup Levels need to be defined and groundwater treatment systems must comply with air emission requirements and the Clean Water Act.

The Groundwater Cleanup Levels (GCLs) define the contaminant concentration levels allowed to remain in the ground water. The purpose of the CERCLA Early Interim Remedial Measure is to reduce the current or potential risk to public health and/or the environment. Therefore, firm cleanup levels need not be established at the time of the interim measure in Dunn Field. Tentative cleanup goals should be established. These cleanup goals will be finalized at a later date through the CERCLA Record Of Decision processes.

Tentative Cleanup Goals can be established to define the contaminant concentration levels allowed to remain in the ground water. The federal Maximum Contaminant Levels (MCLs) will be substituted for the Tentative Cleanup Goals (TCGs). The MCLs will be enforced until the CERCLA ROD process is finalized and Groundwater Cleanup Levels (GCL) have been defined. A list of the TCGs, MCLs and Tennessee guidelines for the contaminants of concern is presented in Table 5.1.

5.3 Air Emission Requirements for Ground Water Treatment

Air emission requirements for ground water treatment systems at Dunn Field must comply with the administrative requirements of the Clean Air Act (CAA), action and chemical-specific ARARs, and Memphis/Shelby County Health Department Air Code regulations.

At the present time, the status of ozone and carbon monoxide air pollutants in Memphis/Shelby County is under review. EPA Region IV is currently reviewing documents (sent by the State of Tennessee on October 1992) for redesignation of Shelby/Memphis County from a nonattainment area to an attainment area for carbon monoxide. In November of 1992, documents were sent to EPA Region IV seeking redesignation of Shelby/Memphis County from a nonattainment area to an attainment area for ozone. At the present time, Memphis/Shelby County is still designated a nonattainment area for lead air pollutants.

TABLE 5.1

Tentative Cleanup Goals
Interim Remedial Measure for Ground Water
DDMT - Dunn Field

Constituent	Tentative Cleanup Goals (TCGs) (ug/L)	Maximum Contaminant Levels (MCLs) (ug/L)	Tennessee Guidelines (ug/L)
Volatile Organic Compounds			
1,1-dichloroethene	7	7	7
cis-1,2-dichloroethene	70	70	70
trans-1,2-dichloroethene	100	100	100
trichloroethene	5	5	5
tetrachloroethene	5	5	5

Source: ES, 1993.

ug/L - micrograms per liter

Emission requirements for ground water treatment systems are handled on an individual basis since emission standards for VOCs have not been defined. The Memphis/Shelby County Health Department has an administrative requirement for a construction-operating permit (Chapter 1200-3-9) before the system goes into operation. Each construction-operating permit is based on the "Best Available Control Technology" (BACT).

6.0 IDENTIFICATION OF TECHNOLOGIES

An interim treatment system controlling contaminant migration in ground water at Dunn Field will have three components: extraction, treatment, and disposal. Several viable technologies and process options are capable of accomplishing these functions. These technologies and process options will be screened to determine which are suitable for further evaluation as part of a treatment alternative.

6.1 Ground Water Extraction

The initial phase in selecting a ground water treatment system is to determine whether it is necessary to bring the water to the surface for treatment or if treatment can take place in-situ. If the ground water is to be brought to the surface, it can be extracted by means of trenches or wells. For an extraction system to be considered viable, it must be able to control migration, be a proven technology, be able to be permitted, and must not be cost prohibitive.

6.1.1 Interceptor Trenches

Trenches, open or buried, may be used for intercepting ground water flow to contain a contaminant plume. Interceptor trenches are primarily used in situations involving shallow ground water due to their low operating costs and efficiency at ground water extraction.

Open trenches require excavation into the aquifer where the ground water flow can be collected. The use of open trenches is limited to very shallow aquifers where an open ditch would not create an undo safety or excavation problem. Buried trenches work on the same principle by creating a zone of high permeability which intercepts ground water and diverts its flow to a collection point. Excavation is still required to the aquifer where a slotted or perforated collection pipe can be buried in highly permeable backfill. The buried trench then acts as a drain which intercepts and/or contains further ground water flow away from a site. The effect of a trench extraction system can be enhanced by installing a highly impermeable barrier on the down gradient side of the trench. This would allow capture of only the ground water flow up gradient of the trench.

The depth to the Fluvial Aquifer at Dunn Field is approximately 60 feet. Trenches of this depth are extremely difficult and costly to construct in a safe manner. Therefore, trenches will not be considered further in selecting alternatives to control ground water migration from Dunn Field.

6.1.2 Wells

Another means of ground water extraction is from wells. Ground water extraction from wells can utilize two systems: well points or pumping wells.

Well points are typically small in diameter, grouped closely together, and are relatively shallow. In a well point system, the wells are connected to a common header pipe and suction pump. Since a suction or vacuum pump can generally only achieve a lift of less than 22 feet, well point systems are suited for ground water extraction in very shallow aquifers or in stratified soil. For the most effective drawdown and ground water containment, the extraction wells in Dunn Field must penetrate the top of the Fluvial Aquifer which is about 60 feet below the surface. Therefore, well point technology is not feasible for application in Dunn Field.

Pumping well systems provide greater flexibility than well points since the wells can be installed at any depth and spacing. Pumping wells are 4 to 12 inches in diameter to accommodate a submersible pump which lifts ground water to the surface. The pump selection is a key component of the pumping well to achieve the desired operating conditions. Installation costs are higher due to the larger size and greater depth of pumping wells. Spacing of the wells is dependent upon the anticipated drawdown and distance-drawdown in the aquifer. Over lapping of capture zones can effectively intercept a plume which is wider than the capture zone of one well.

Pumping wells can be configured in a variety of ways to assist in controlling contaminant migration in an aquifer. The wells can be placed on the down gradient perimeter of the plume to intercept and extract contaminants to prevent their migration. The wells can also be placed near the center of the plume to extract all contaminated ground water flowing down gradient from the source and reverse the flow of the contaminants already down gradient from the well.

There are additional techniques that can be used with pumping wells to increase their effectiveness in preventing ground water migration. Slurry walls can be used to create a physical barrier either down gradient to prevent further migration or up gradient to prevent ground water flow beneath the source of contamination. Reinjection of treated ground water can be used down gradient of the contaminant plume to accelerate ground water flow back toward the extraction wells. Reinjection wells installed up gradient of the plume can assist by accelerating ground water toward the extraction wells. These techniques can supplement the effectiveness of pumping wells in controlling contamination migration.

For the purposes of this Interim Remedial Measure to control ground water migration from Dunn Field, pumping wells will be retained for further consideration as a component of an alternative. At this time there is not sufficient data available to determine the location of the down gradient edge of the plume. Therefore, neither pumping wells nor reinjection wells placed down gradient of the plume will be considered. The use of pumping wells within the plume and reinjection wells up gradient of the plume will be retained for further consideration as components of alternatives. Physical barriers will not be considered further since the location of the sources and the extent of the plume is unknown.

6.2 Treatment

Contaminants in ground water must be removed or destroyed before the water can be safely released into the environment. The Law Study (1990 Law) found elevated levels of VOCs and metals in the ground water at Dunn Field. Samples taken during the pumping test (1992 ES) and in 1993 contained only VOCs above action levels. Therefore, a system for treating ground water in the Fluvial Aquifer at Dunn Field must reduce VOCs.

Treatment processes for liquid wastes fall into three broad categories: physical treatment, chemical treatment and biological treatment. All of these treatment processes could be utilized individually or in combination at Dunn Field to effectively treat ground water contaminated with VOCs. Some of these processes can be carried out *in-situ* without having to extract the ground water.

6.2.1 *In-situ* Treatment

In-situ treatment of the ground water would employ the use of physical, chemical or biological technologies to degrade, immobilize or remove the contaminants. Current technologies for *in-situ* treatment of ground water contaminants include bioremediation, chemical immobilization, chemical mobilization, chemical detoxification, and vapor extraction. Elements of *in-situ* treatment which must be addressed include methods of delivering treatment reagents to the subsurface and methods for containing the spread of contaminants and reagents beyond the treatment zone.

In-Situ Bioremediation - Bioremediation is a process that uses the soil's naturally occurring microorganisms to decompose toxic or hazardous organic compounds. Successful *in-situ* bioremediation has been performed on contaminated soils and ground water through stimulation of indigenous organisms by the addition of oxygen and nutrients.

Implementation of bioremediation technology is controlled by the specific contaminants and the hydrogeologic conditions. To evaluate a site's suitability for bioremediation would require thorough site characterization, laboratory treatability studies, and a bench-scale study.

The characterization would include an assessment of the organic and inorganic chemicals present, the disposition of the waste, indigenous microbial activity, toxicity, and soil and ground water chemistry. Chlorinated solvents such as those present in the ground water at Dunn Field are not readily biodegradable using in-situ techniques. The limited knowledge of the extent and characteristics of the zone of contamination around Dunn Field further restrict the development of bioremediation as an interim treatment technology. The hydrogeological conditions dictate the method for delivery of treatment reagents to the subsurface and methods of controlling the spread of contaminants and reagents beyond the treatment zone.

Laboratory treatability studies would be required to confirm the viability of biological treatment and to identify the conditions required to stimulate the available biomass. Next, a bench-scale study, including a complete material balance, would be used to determine the fate of contaminants and define the process in greater detail. The intermediate products of microbial metabolism may sometimes result in compounds which are more hazardous than the original contaminant. The time necessary to perform these analyses has adverse effects on the expeditious establishment of an interim treatment system.

In-Situ Chemical Immobilization - Immobilization processes are designed to stabilize or solidify the contaminant thereby reducing the waste's solubility, toxicity, or mobility. Most stabilization and solidification processes involve the addition of materials to the waste which, in the case of the ground water at Dunn Field, would require numerous injection wells. The resulting immobilized contaminants would remain in place beneath

Dunn Field. Most stabilization and solidification technologies are effective on inorganics and metals but have limited application for organic compounds which are of primary concern at Dunn Field.

In-situ vitrification, the process of heating the contaminated soil area until it becomes a molten solid has shown success at immobilizing organic contaminants. Implementation of the *in-situ* vitrification process would vaporize the ground water or would require numerous wells in draw down the ground water in the aquifer.

The large size of the potential area of contamination and the relatively dilute concentrations of the wastes would result in prohibitive costs if *in-situ* immobilization technologies were to be used. Stabilization and solidification would be more effective options for treating relatively small, defined "hot spots" of contaminated soil. Therefore, stabilization and solidification will not be considered further as treatment technologies for the contaminated ground water at Dunn Field.

In-Situ Chemical Mobilization - Chemical mobilization, or "soil flushing", is the process of applying a liquid agent to the contaminated soil which renders specific contaminants soluble. The mobilized aqueous contaminants can then be removed from the ground for treatment. This technology has been effective at removing organic, inorganic, and metal contaminants. Most applications of chemical mobilization require that the contaminated soil be excavated. Since excavation is not desirable at Dunn Field *in-situ* chemical mobilization will not be considered further as a treatment technology. Use of chemical mobilization may have merit at Dunn Field if combined with a pump and treat alternative to make the contaminants more soluble for transport to the surface for treatment.

In-Situ Detoxification - Detoxification technologies utilize the chemical reactions of hydrolysis, oxidation/reduction, and neutralization to transform contaminants to a less toxic state. *In-situ* detoxification would require the addition of reagents to initiate the desired chemical reaction. Certain metals are the only compounds which detoxification would be an effective treatment technology. Due to the variety of contaminants, particularly organic compounds, present in the ground water at Dunn Field, this technology will not be considered further.

In-Situ Vapor Extraction - Vapor extraction is a proven *in-situ* process for removing volatile and semi-volatile organic compounds from the unsaturated zone of soil. Vacuum pumps or blowers are used to induce an air flow through the soil. The volatile organic compounds are desorbed from the ground water and soil into the air stream. A trench or network of extraction wells is constructed to collect the air for treatment on the surface before release into the atmosphere.

Vapor extraction is an effective means to remediate a site once the source of contamination has been removed and the extent of the contaminant plume has been defined. Neither condition has been accomplished at Dunn Field. The primary media which vapor extraction affects is soil. The ground water is approximately 60 feet below the surface at Dunn Field. Soil vapor extraction would have limited effect at remediating the ground water at this depth. For these reasons, in-situ vapor extraction will not be considered as a ground water treatment technology at Dunn Field.

6.2.2 Activated Carbon Adsorption for VOCs Removal

Activated carbon adsorption is a chemical process of collecting soluble substances onto the surface of activated carbon. Treatment of water containing VOCs can be accomplished by passing the water through a single or series of activated carbon packed bed reactors. As the water comes in contact with the activated carbon, VOCs are attracted to the surface of the carbon particles.

A typical carbon system uses granular activated carbon in a series of downflow reactor vessels. The size of the reactors and flow rate through the reactors must be designed to achieving sufficient contact time for the VOCs to adsorb to the carbon. In addition to contact time, the effectiveness of carbon adsorption depends on the available surface area of carbon and the strength of the molecular attraction between the carbon and VOCs. As the carbon continues to adsorb VOCs, the strength of the attraction to the carbon granules decreases. Periodic monitoring will indicate when the adsorptive capacity has lost its effectiveness and the carbon is categorized as spent.

To optimize performance of activated carbon water treatment, the suspended solids concentration in the water must be low. Suspended solids, which might otherwise get caught in the carbon bed, should be removed prior to contact with the activated carbon. Suspended solids can usually be removed by physical means such as sedimentation or filtration. Ground water tested following 42 hours of extraction from the pump test well in Dunn Field in September 1992 contained a suspended solids concentration of 1 mg/L (1992 ES).

Economical application of carbon treatment depends on an efficient means of regenerating the carbon after its adsorptive capacity has been reached. Vendors of carbon treatment units offer regeneration services. Carbon can be regenerated on site using an incinerator to oxidize the organic matter to remove it from the carbon surface. In addition to the operating costs of on site incineration, air emission permits would also be required. Each regeneration destroys about 5 to 10 percent of the carbon, and regenerated carbon has less adsorptive capacity than virgin carbon. Spent carbon which is not regenerated would require disposal as a hazardous waste.

For the long duration and large quantity of ground water to be treated during this Interim Remedial Measure, regeneration will be necessary. Using activated carbon as the primary means of ground water treatment demand the expensive operation and maintenance of a carbon adsorption and regeneration system at Dunn Field. Therefore this technology will be retained as a possible component of a treatment alternative.

6.2.3 Air Stripping for VOCs Removal

Air stripping is a physical process of mixing water contaminated with volatile organics with clean air. The intimate contact of the water and air cause a mass transfer of the volatile organics from the liquid to the gaseous phase. Two categories of air stripping processes are used: dispersing air in liquid or dispersing liquid in air.

Air stripping which puts air through liquid typically involves bubbling or mixing air through a volume of stored water. This requires an air compressor or drive motors to generate pressured air or turbulent mixing thus requiring a great deal of energy.

The more frequently used air stripping systems disperse liquid through air. Typical air stripping devices in this category include packed tower aerators, redwood slat aerators, cooling towers, and spray towers. These systems create water droplets or a water film to facilitate mass transfer as the water passes countercurrent to the air.

Packed towers with ceramic, plastic or glass media are the most common air stripping devices. The contaminated water enters at the top of the tower and trickles down across the media thus encouraging contact with air. Air is forced upward using an air blower. The volatile organics transfer to the gaseous phase and are exhausted with the air out the top of the tower. The air to water ratio required is generally less than 100 to 1. A properly designed and operated air stripping tower typically achieves 99 percent removal of volatile organics in the water effluent.

For most efficient operation, water being treated by air stripping should be low in suspended solids. During the pump test in Dunn Field in September 1992, the extracted water contained approximately 1 mg/L suspended solids, which would easily pass through an air stripping system without affecting its operation. Therefore filtration of the extracted water prior to air stripping would not be required.

A typical packed tower will be 3 to 10 feet in diameter depending on the flow rate desired and 10 to 30 feet in height depending on the level of cleanup required. Towers are generally readily available and can be obtained as mobile units. Operation is relatively simple and maintenance costs are low making air stripping a technology which would be well suited for use at Dunn Field.

Since volatile organics would be released to the atmosphere, air emission requirements would be a factor in the design and operation of an air stripping tower. Carbon adsorption, as described above, is an effective means of capturing the volatile organics from an air stream. The air flow from the air stripper would be conveyed to an activated carbon system for removal of the VOCs. This system would consist of two tanks, operating in series, that would be exchanged when the first tank becomes saturated with VOCs. Spent carbon would either be transported off-site for disposal or regeneration, or regenerated on-site using a thermal treatment system. On-site regeneration would only be practical if enough VOCs were produced to make this economically justified. A properly designed and operating activated carbon scrubber can achieve greater than 99 percent removal of volatile organic compounds from air. This effective VOC reduction should meet all ambient air quality requirements.

Air stripping using a packed tower and an optional activated carbon adsorption air scrubber will be retained and incorporated into an alternative for treatment of extracted ground water from Dunn Field.

6.2.4 UV/Oxidation for VOCs Removal

Oxidation is a chemical process which can be used to destroy organic contaminants. Recent developments in oxidation technologies, known as advanced oxidation processes, have demonstrated success at treating VOC contaminated waters. Ozone and hydrogen peroxide are commonly used as oxidizing agents. Radiation from ultraviolet (UV) light may be categorized as a catalyst to the oxidation process using ozone and/or hydrogen peroxide.

ULTROX International has developed process which uses UV light plus ozone and/or hydrogen peroxide. The process was demonstrated to the USEPA as part of a Superfund Innovation Technology Evaluation study in 1989. The ULTROX process was proven to be an effective means of treating ground water contaminated with VOCs to below detectable levels.

The ULTROX treatment system consists of the following major components: a UV/oxidation reactor, an air compressor/ozone generator module, a hydrogen peroxide feed system and a catalytic ozone decomposition unit. Low intensity UV lamps, also known as mercury vapor lamps, are used to produce the UV radiation. The hydrogen peroxide is mixed with the wastewater stream which flows through the reactor at a predetermined hydraulic detention time for adequate exposure to the UV light. Ozone is transferred to the contaminated water forming hydroxyl radicals which are powerful chemical oxidants capable of breaking down a wide variety of organic contaminants. When carried to completion, the end products of such a process are carbon dioxide, water and chlorine. Ozone which is not fully transferred to the water is captured in the ozone decomposition unit. Thus, no harmful ozone is released into the atmosphere.

The primary appeal of UV/oxidation over the other treatment processes is that it provides final treatment. There is no residuals or contaminant release into the air which would require additional treatment. The primary concerns with this system is safe handling of the priority pollutant, ozone, and susceptibility of the UV lamps to fouling which diminishes their effectiveness. As cases of successful use of UV/oxidation continue to rise, these concerns are diminishing.

Treatability studies would be necessary before implementation on the ground water at Dunn Field. Since the technology is still relatively new, there would be a greater degree of technical expertise needed to oversee the operation of a UV/oxidation system. Both of these aspects contribute to the already higher cost of acquiring and operating a UV/oxidation treatment system. Vendors such as ULTROX International justify the higher cost over time by assuming that other treatment alternatives will require additional residual or air treatment.

Properly designed, UV/oxidation has proven to be a successful method of treating ground water contaminated with VOCs such as are present at Dunn Field. Therefore, UV/oxidation will be retained as an alternative for treatment of extracted ground water from Dunn Field.

6.2.5 Biological Treatment for VOCs Removal

Extracted ground water containing VOCs may be treated in biological treatment reactors. In most applications, aerobic biological treatment processes are used for removal of hazardous organic matter. Aerobic biological treatment reactors can be separated into two major categories: suspended-growth reactors and fixed-film reactors.

In suspended-growth reactors, bacterial growth occurs in the water, which is thoroughly mixed to promote oxygen transfer to the microbes for respiration. Oxygen and other macronutrients, such as nitrogen and phosphorus, are supplied in these reactors by mechanical means, such as air diffusers and chemical feeders. Examples of treatment operations which utilize suspended-growth reactors include activated sludge and aerated lagoon processes. A disadvantage of suspended-growth reactors is that due to the relatively long hydraulic detention time required, a large reactor size is required.

In fixed-film reactors, bacteria grow on an inert support medium. Contaminated water is distributed over the medium, allowing organic matter to contact and be consumed by bacteria. Oxygen is supplied from the atmosphere or by forced air blowers. Macronutrients must be injected into the system. The two primary types of fixed-film reactors are trickling filters and rotating biological contactors. Because of their module construction and adaptability to flow and contaminant concentration variations, rotating biological contactors (RBC) would be best suited for implementation at Dunn Field.

A RBC consists of multiple plastic discs mounted on a horizontal shaft. The shaft, at a right angle to wastewater flow, rotates with about 40 percent of the total disc area submerged. The bioadsorption and bio-oxidation take place on the surface of the disc. To achieve higher contaminant removal, multiple RBC can be connected in series creating a longer hydraulic detention time but also requiring a larger designated treatment area. Microbial growth which sloughs off the RBC must be removed by final clarification in a settling tank. Sludge from this clarifier will require treatment or disposal in a hazardous water landfill. In cold climates, RBC must be covered since biological activity may be significantly reduced. Gas emissions may result which require monitoring and/or treatment before release into the atmosphere.

Laboratory treatability studies would be required to confirm the viability of biological treatment and to identify the conditions required to stimulate the biomass. Next, a bench-scale study, including a complete material balance, would be used to determine the fate of contaminants and define the process in greater detail.

The time necessary to perform these analyses has adverse effects on the expeditious establishment of an interim treatment system. Biological treatment is complicated by the sensitivity and expertise necessary to operate a properly functioning system. The requirement for a finishing step in water treatment, treatment and/or disposal of sludge, and monitoring and/or treatment of air emissions further increases the effort and expense to treat VOC contaminated ground water using biological means. Therefore, biological treatment will not be retained for further consideration as a alternative for ground water treatment at Dunn Field.

6.2.6 Off-Site Treatment

An option to establishing and operating a facility at Dunn Field capable of treating the contaminated ground water would be to transport the water off-site for treatment.

Off-site treatment could be performed at an existing, permitted treatment facility already capable of treating and disposing of water with contaminants similar to those found in the ground water at Dunn Field. Most municipal wastewater treatment systems could not adequately remove VOCs. Thus a specialized industrial wastewater treatment facility would be needed to handle this ground water.

Transportation presents an insurmountable problem. Assuming 520 gpm of ground water is being extracted, and tank trucks equipped to haul 6,500 gallons, one trunk would be required every 12.5 minutes. To be effective, the ground water extraction system must operate 24 hours per day, year round. The intense dedication of tank trucks and sufficient drivers to accomplish this task is not feasible.

Therefore, off-site treatment of ground water from Dunn Field will not be considered further. Off-site treatment and/or disposal of residuals produced from other treatment systems may be incorporated into an alternative for ground water treatment at Dunn Field.

6.3 Disposal

Following extraction and treatment of the contaminated ground water, an appropriate remedial action alternative must identify an approved method of disposing or releasing the water. The disposal route is a critical factor since the method of discharge may determine the ground water clean up levels and associated permits which will be required.

The following discharge routes will be considered: discharge to a Publicly Owned Treatment Works (POTW), discharge to surface storm water drainage system, or re-injection of the water back into the ground via wells or infiltration. For a disposal route to be considered viable, it must be able to handle the flow rate, be able to be permitted, and must not be cost prohibitive.

6.3.1 Discharge to POTW

The treated ground water could be discharged into the Memphis sanitary sewer system. Wastewater from the Dunn Field area is conveyed to the City of Memphis - South Waste Treatment Facility. Hydraulic capacity at this facility is available to handle treated ground water discharges from Dunn Field. The hydraulic capacity of sanitary sewers serving the Dunn Field area is not likely to accommodate the additional flow. Administrative requirements, in the form of a System Discharge Agreement (see Appendix D) would need to be met before this action could be implemented. The city would accept certain loadings of contaminants in the effluent based upon the types of constituents the POTW is equipped treat.

6.3.2 Discharge to Surface Drainage

The contaminated ground water could be sufficiently treated to meet substantive NPDES requirements and then discharged in close proximity to the site along the northern boundary of Dunn Field. A suitable surface drainage channel lies along the north boundary of Dunn Field which leads north to Cane Creek and thence to Nonconnah Creek. Section 121(e) of CERCLA exempts any response action conducted on-site from having to obtain a Federal, State, or local permit. Under the Clean Water Act, operation of the preferred alternative would be considered to be a "direct" discharge. By EPA definition, direct discharge of wastewater is considered to be on-site if the receiving water body is in the area of contamination or is in the very close proximity to the site and is necessary for implementation of the response action (even if the water body flows off-site) (August, 1988 USEPA; August, 1989 USEPA; and OSWER Directive 9234.1-02) . The NPDES permit that DDMT currently holds is for storm water only. DDMT would have to file a modified NPDES permit application to describe the additional discharge locations, the continuous discharge rate and required constituent levels for the on-site treatment system in order to solicit substantive ARARS. However, the administrative requirement for either a permit or permit-equivalent would not be applicable because this will be an on-site discharge in accordance with OSWER Directive 9355.7-03.

If this strategy were employed for disposal of treated water, the ability of the drainage system to accommodate the additional flow during both dry weather and wet weather would need to be considered. Furthermore, the added flow could potentially enhance scouring of stream banks and degrade down stream water quality. In addition, water in the channel could potentially infiltrate surrounding soils and, if contaminants are present in those soils, create leaching and added mobility of those contaminants toward ground water.

6.3.3 Reinjection or Infiltration

The treated water could be returned to the Fluvial Aquifer by reinjection or infiltration. The treated water could also be disposed of by injecting it into a deeper formation.

Reinjection - As previously discussed, the treated ground water could be reinjected into the Fluvial Aquifer in a manner which would help control contaminant migration. Reinjection down gradient of the contaminant plume could reverse the gradient in the ground water and accelerate the movement of contaminants back toward the extraction wells. Since the plume extent is not fully defined, this action could also accelerate the movement of contaminants away from Dunn Field. For this reason, reinjection down gradient will not be considered further.

Reinjection wells placed up gradient of the sources of contamination could assist in flushing the contaminants from beneath the burial zone but would not necessarily help control migration. Permitting of any reinjection system would be required and may create obstacles to implementation but upgradient reinjection will be retained as a disposal alternative.

Infiltration - Treated water would be released onto the ground surface and allowed to saturate and then infiltrate through the soil into the Fluvial Aquifer. Used over the burial areas or up gradient from the burial areas, this method of discharge would aid in flushing the contaminants out of the soil and toward the extraction wells for treatment. However, moving the contaminants deeper into the soil and closer to the Fluvial aquifer will not contribute to a permanent solution. Therefore, infiltration in Dunn Field will not be considered further. Infiltration downgradient would require setting aside acreage to receive the treated water. Sufficient land area is not likely to be available nearby, and would pose conflicts with surrounding residential and institutional land uses. Therefore, infiltration downgradient will not be considered further as a means of disposal of treated ground water.

Deep Well Injection - Treated ground water could be injected into any of several aquifers beneath the site. The State of Tennessee has classified all of these aquifers for drinking water or injection purposes. The Memphis Sand Aquifer beneath Dunn Field is set aside for drinking water, and the other aquifers are not suited for reinjection. The only deep aquifer available for injection in the state is near central Tennessee. Due to the problems of logistics and high transportation costs, deep well injection will not be considered further as a means of disposal of treated ground water.

6.4 Screened Technologies

The technologies and their process options which have been reviewed are summarized in Table 6.1. Those which have been retained for consideration as part of an extraction, treatment, and disposal alternative are noted.

TABLE 6.1

Technologies Screened and Retained for Consideration at Dunn Field

Function	Technology	Process Option	Retained
In-Situ	Physical or Chemical Processes	Bioremediation	
		Chemical Immobilization	
		Vitrification	
		Chemical Mobilization	
		Detoxification	
		Vapor Extraction	
Extraction	Interceptor Trenches		
	Wells	Well Points	
		Pumping Well	X
		Pumping Well with Reinjection	X
Treatment	Activated Carbon Adsorption		
	Air Stripping	No Emission Treatment	X
		Emission Treatment	X
	UV/Oxidation		X
	Biological Treatment	Suspended Growth	
		Fixed Film	
	Off-Site Treatment		
Disposal	POTW		X
	Surface Water Discharge		X
	Reinjection	Down Gradient	
		Upgradient	X
		Infiltration	
		Deep Aquifer	

Source: ES, 1993.

7.0 HYDROGEOLOGIC IMPACTS

7.1 Introduction

The conceptual design of a system to control contaminated ground water in the Dunn Field vicinity of DDMT can be efficiently performed using mathematical models. Ground water models are available offering a range of complexity and sophistication. Simple analytical models are available to make an idealized analysis of flow and drawdown. Semi-analytical and numerical models can be used for more sophisticated evaluations, such as to account for spatial variations of soils, other 3-dimensional factors, or chemical transport effects.

The objectives of modeling the Fluvial Aquifer beneath Dunn Field are to evaluate flow control created by various patterns of extraction wells. Data to be used in this analysis was developed during the Law Study (1990 Law), along with data from the pump test conducted in Dunn Field (1992 ES). Other data gathered by previous studies has also been used in planning this evaluation. While there are limitations to this data which may prevent the application of sophisticated models, nevertheless the use of models is appropriate to evaluate and compare different scenarios.

The models to be considered here are suited for simulating the hydraulic behavior of aquifers. More complex models which simulate both the hydraulic behavior and chemical transport are limited by the lack of site-specific data to calibrate them. Therefore a key assumption in the modeling is that the contaminants move through the aquifer like the water does. This is a good approximation for a conceptual design at Dunn Field, since the fluvial aquifer is only 15 to 20 feet thick and can be modelled as a two-dimensional system. Furthermore, since extraction wells would be screened across the entire aquifer thickness, these wells would be suitable of capturing a variety of contaminants regardless of density or other physical properties. This assumption is appropriate for the constituents of concern in Dunn Field, which include VOCs.

7.2 Selection of Model

Two ground water models, MODFLOW and DREAM, were considered for use in evaluating ground water control scenarios. The first model considered was MODFLOW, a numerical model developed at the U.S. Geological Survey for modeling aquifer responses to various stresses. MODFLOW allows use of combinations of different modules (specification of grid size, well placement, and recharge) and boundary conditions, such as active or inactive areas. The combination of modules and the resulting output are expressed in numerical terms that approximate the responses of actual aquifers to pumping, reinjection, or other stresses. The output from MODFLOW is expressed as changes in head and calculation of water budget.

An effort was made to calibrate MODFLOW to the Dunn Field environment. The conceptual model of the Fluvial Aquifer was an unconfined sandy layer underlain by an impermeable clay. General ground water flow was to the west with a gradient of 0.01 to 0.02 feet per foot. This conceptual model was expressed as a one-layer grid of varying cell sizes that increased in all directions away from Dunn Field. Input consisted of known and inferred ground water elevations from September 1992 and elevations of the aquifer bottom.

Prior to evaluating response to stress, a numerical model should produce steady-state conditions with no stress on the system, followed by calibration of the model to known stress such as a pumping test. However, applying MODFLOW to the Fluvial Aquifer did not achieve the known steady-state conditions of measured ground water elevations and a constant water budget. To test the steady-state conditions, the input from inferred ground water elevations east, west, and north of Dunn Field were varied, as were the inferred aquifer bottom elevations. The model grid size and cell variability were also changed in different simulations so as to best approximate steady-state conditions. The general responses of the model to steady-state simulations were as follows:

- Modeling a small grid of 1200 feet by 1200 feet produced dewatering of cells, a situation not known to exist in the Fluvial Aquifer.
- Modeling with larger grids of 3400 by 4800 feet and 6200 by 7000 feet produced an unbalanced water budget and rising (rather than stead-state) ground water elevations across the site. Changes in cell variability and boundary conditions did not significantly alter these results.

The problems with a MODFLOW steady-state simulation of the site were not resolved. The lack of hydrogeological data north and east of Dunn Field may have hindered model calibration, particularly if this area exhibits geological features or water tables different from what has been observed to date. Without steady state conditions satisfied, calibration simulations and testing of extraction well scenarios cannot give valid results.

An analytical model program (DREAM) was then considered to represent extraction scenarios at Dunn Field. This program was developed at the University of Oregon (1990 Bonn and Rounds) and uses basic ground water-related equations to predict the effects of stresses on ground water systems. Within stated limitations, this program can be used an estimate of ground water flow conditions and an analytical tool for evaluation of pumping and injection systems. It does not replace the precision and accuracy possible with numerical modeling programs, but it does provide a working estimate of the result of stress on simple ground water systems and has been used with a variety of ground water flow problems. DREAM was thus selected for evaluation of pumping scenarios at DDMT.

DREAM calculates drawdowns, water level elevations, steady-state velocities, and steady-state streamlines. The transient drawdown and water levels are calculated using the Theis equation. The Theis equation describes unsteady, radial flow to a well completed in a confined aquifer. The basic assumptions for the model are the same ones which apply to the Theis equation. These include:

- The aquifer is homogeneous, isotropic, confined, of uniform thickness, and of infinite areal extent.
- Before pumping, the piezometric surface is horizontal. The well is pumped at a constant rate.
- The pumped well penetrates the entire aquifer, and flow to the well is horizontal.
- Flow to the well is laminar.
- The well diameter is infinitesimal so that storage in the well can be neglected.
- Water removed from storage is discharged instantaneously with decline in head.

The values of the stream function are calculated using a complex velocity potential (1985 Granger) which is defined only for steady-state systems.

The DREAM model, although simplistic and designed for confined aquifers, provides a good estimation of the Fluvial Aquifer's response to various pumping scenarios. Although the aquifer is assumed to be of uniform thickness, this condition is not true in an unconfined aquifer during pumping due to dewatering of the aquifer. Jacob (1944) proposed that a corrected drawdown value could be calculated and then be used in the Theis equation. However, DREAM does not correct the drawdowns using the Jacob method. Therefore the drawdowns calculated and subsequent water levels calculated by DREAM must be considered as approximate.

7.3 DREAM Model Calibration

The DREAM model was applied to the Dunn Field area using a rectangular grid 3,000 feet east-west by 4,000 feet north-south. The pump test well was placed in the center of the grid at the origin. The location of each of the proposed extraction wells for each scenario was plotted on the grid and given an X coordinate and a Y coordinate based on its location relative to the pump test well.

After the grid was established, the model was calibrated using aquifer parameters from the pumping test conducted in September, 1992. The aquifer parameters used were:

Storage coefficient:	0.19
Transmissivity:	1994 ft/day
Natural gradient:	0.015
Flow direction:	west
Aquifer thickness:	20 feet
Porosity:	0.20

The natural gradient and the flow direction were based on static water level measurements collected from the wells in the Dunn Field area in September, 1992. An approximation to the static water table is shown in Figure 7.1. Due to the simplicity of the model, the gradient was assumed to be constant across the site. An average of the gradients from the north end, where the gradient is the higher, and from the south end, where the gradient is lower was used. Figure 7.2 shows the actual September, 1992 contours superimposed on the simplified contours used in the DREAM model based on an average gradient. Although the simplified contours do not match the actual site conditions, the figure shows that they are close and that the simplified contours should provide a good estimation of the Fluvial Aquifer. Furthermore, using the same contours as the starting point for each scenario aids in comparing the effect of different scenarios.

7.4 Simulations of Candidate Pumping Scenarios

Numerous trials were performed using the DREAM model to develop an understanding how pumping would affect the contaminated area identified during the Law Study. The pump test conducted in 1992 (see Section 3.5) revealed that a single well in the Fluvial Aquifer has a specific capacity of 5.8 gpm per foot. For a pumping well in a 20 foot thick aquifer, the maximum operational drawdown should be about 67 percent of the

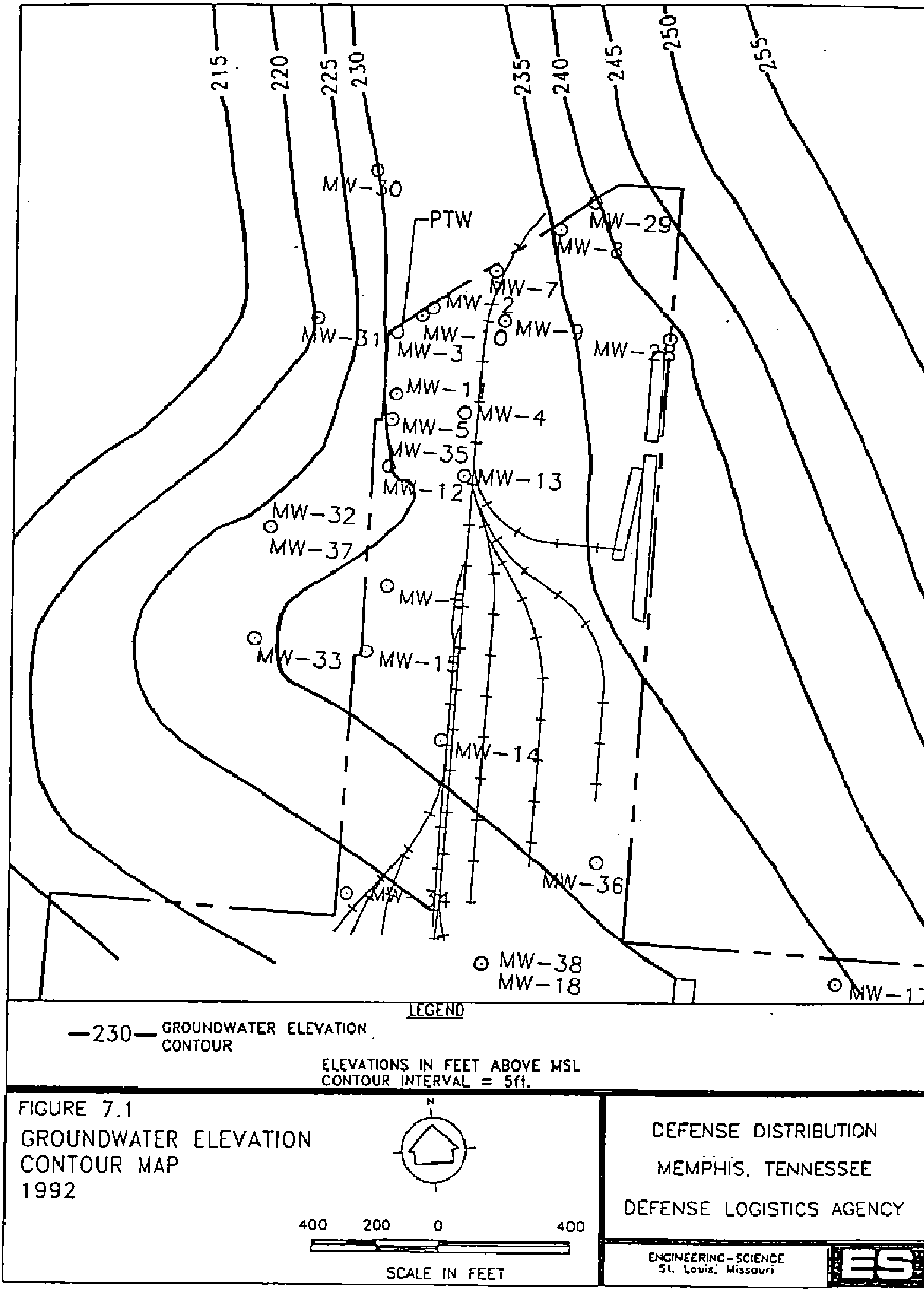

FIGURE 7.1
GROUNDWATER ELEVATION CONTOUR MAP
1992

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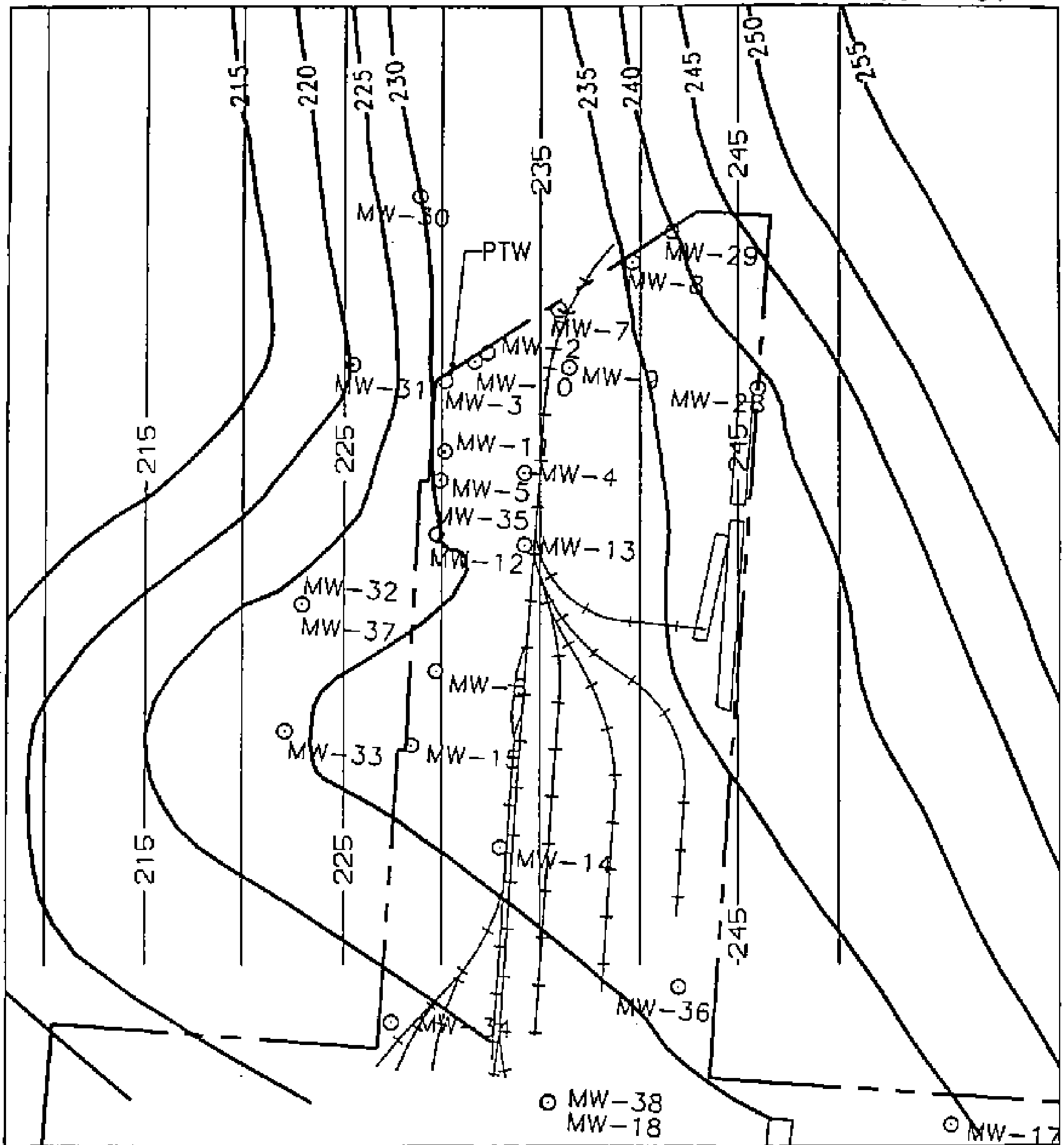

LEGEND

—230— GROUNDWATER ELEVATION CONTOUR

—215— SIMULATED GROUNDWATER ELEVATION CONTOUR

ELEVATIONS IN FEET ABOVE MSL
CONTOUR INTERVAL = 5ft.

FIGURE 7.2
SIMULATED GROUNDWATER ELEVATION CONTOUR MAP

N

400 200 0 400

SCALE IN FEET

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ES

aquifer thickness (or about 13 feet). Based upon the specific capacity, a discharge of 75 gpm achieves this drawdown. Simulations with DREAM suggested that a single well provided a capture zone that was about 200 to 300 feet wide. Therefore several trials were performed using multiple wells to understand how these wells modified the flow patterns beneath Dunn Field. These trials can be grouped into three categories:

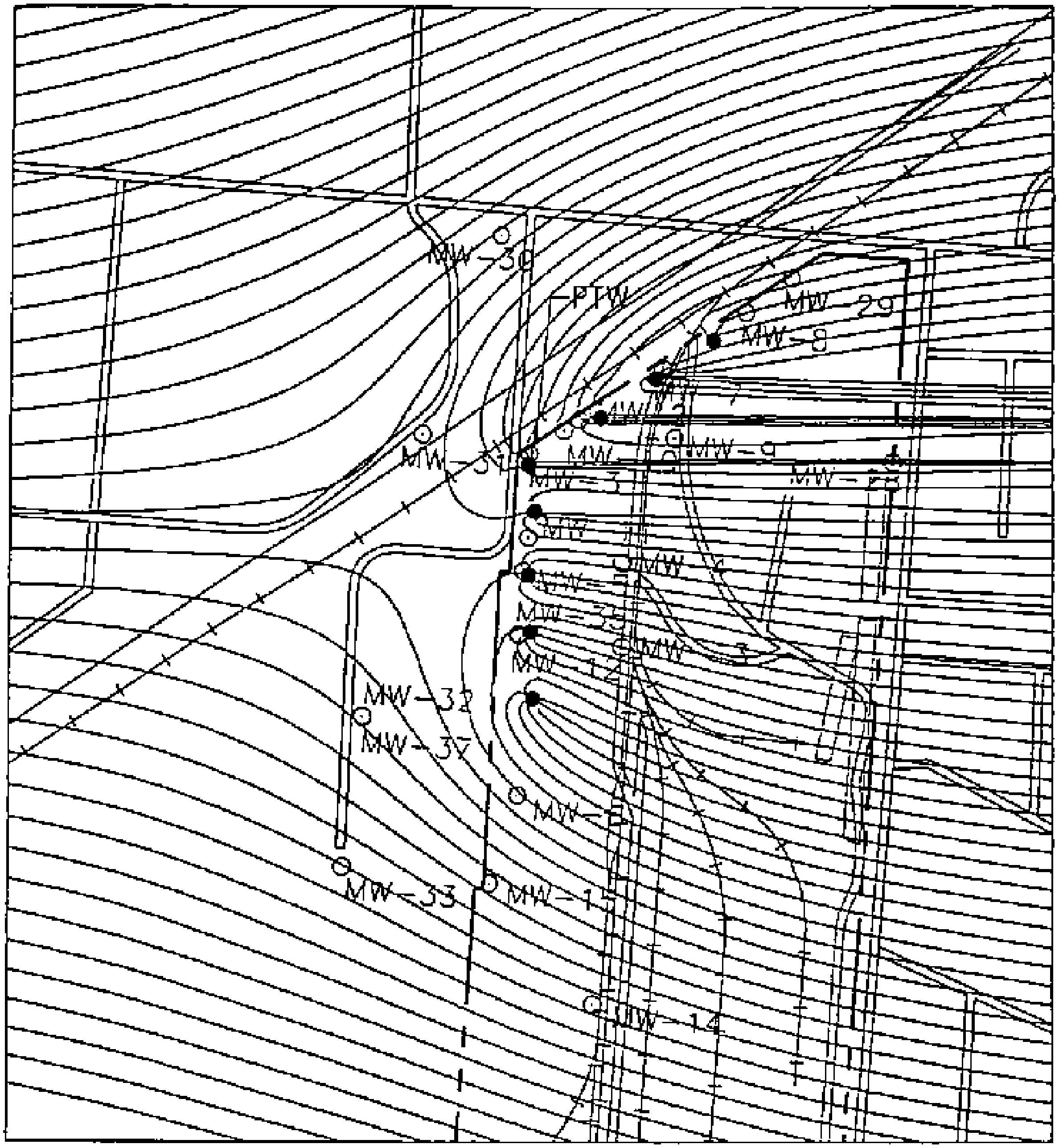
1. Extraction wells within Dunn Field
2. Extraction wells in Dunn Field and off-site downgradient
3. Extraction and Reinjection wells within Dunn Field

Further trials within these categories revealed only small differences between numbers of wells, flow rates, and capture zones. Therefore these three categories were used as the basis for the following three scenarios.

The duration of pumping can be set for each trial. Modeling short durations of pumping, on the order of days to weeks, predicts a zone of influence relatively close to the pumping locations. Pumping for longer periods, on the order of one to five years, approximates continuous pumping scenarios. In all the scenarios that follow, the duration of pumping was fixed at 5 years. Simulations of longer pumping periods are not productive, since changes in streamflow lines are insignificant beyond this time.

7.4.1 Extraction Wells On-Site (Scenario 1)

Scenario 1 consists of 8 extraction wells all located along the northwest and west boundaries of Dunn Field. The proposed locations of these extraction wells are shown in Figure 7.3 along with the streamlines of flow into these wells. The total flow rate from these wells of 520 gallons per minute (gpm). The southern-most six wells are pumped at 75 gpm, while the two northern-most wells are pumped at 40 gpm and 30 gpm (proceeding northward). Well spacing is approximately 200 feet across the gradient and produces effective control of the streamlines up gradient. The wells to the north are spaced farther apart because they are not perpendicular to the gradient.



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● EXTRACTION WELL LOCATION
○ EXISTING MONITOR WELL LOCATION

FIGURE 7.3
SCENARIO 1

N

400 200 0 400
SCALE IN FEET

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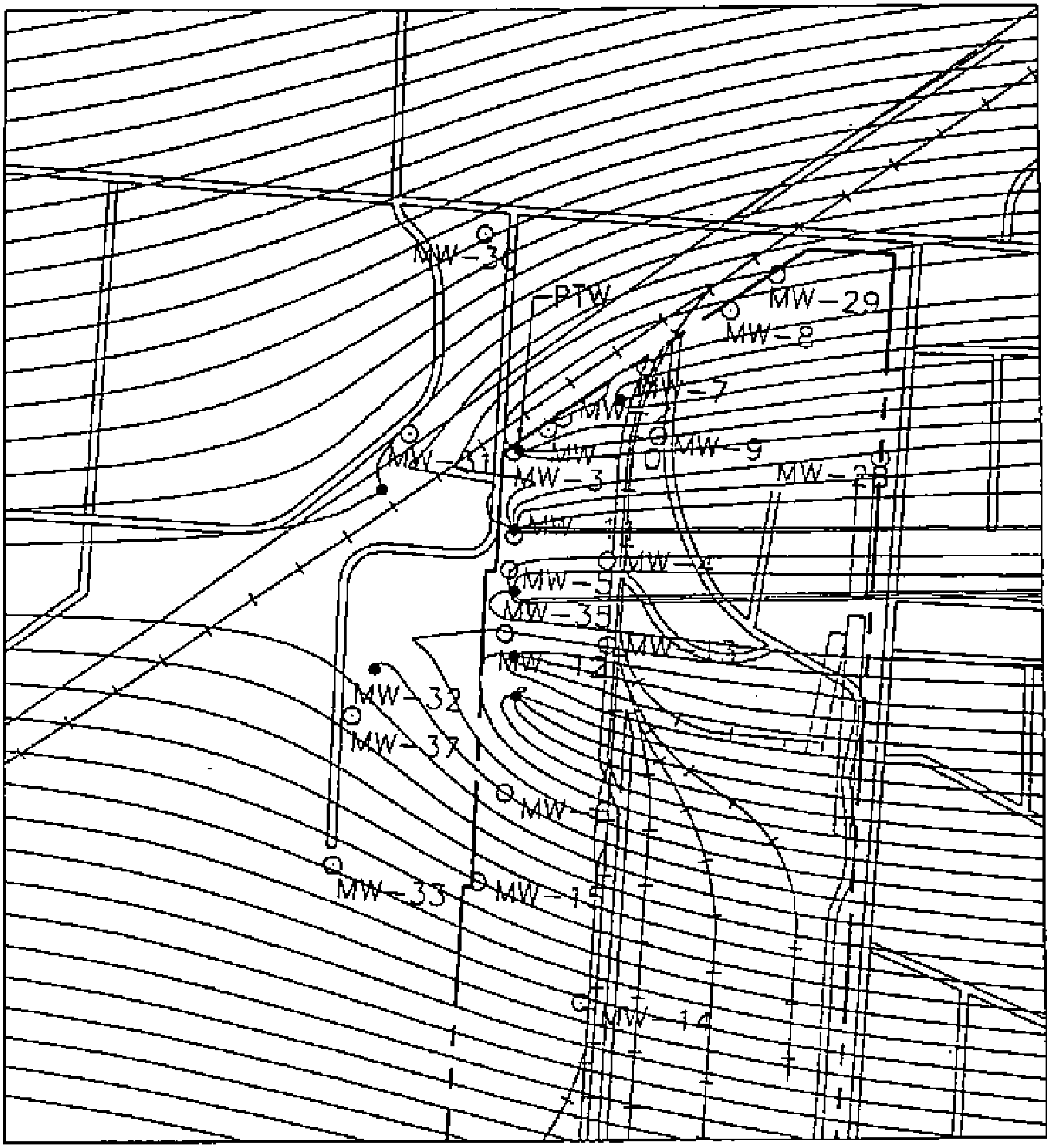
Pumping rates were reduced to the north to avoid completely dewatering the aquifer. The contaminated ground water beneath Dunn Field identified during the Law Study field investigations (see Section 3.5) is completely captured by these wells. This area is estimated to cover some 25 acres. The approximate zone of capture for this scenario is 28 acres of Dunn Field west of the East Boundary, plus another 12 acres off-site (to the north and west of Government property). The zone of capture extends approximately 230 feet west of Dunn Field and approximately 360 feet north of the North Boundary of Dunn Field.

7.4.2 Extraction Wells On/Off-Site (Scenario 2)

Scenario 2 consists of eight extraction wells, six located on-site and along the northern and western boundaries of Dunn Field and two off-site approximately 350 feet west near Rozelle Street (see Figure 7.4). Well spacing along the western boundary of Dunn Field is approximately the same as Scenario 1. Two wells from the north are moved off-site down gradient in an effort to capture more of the off-site contamination. Because the line of on-site wells is only 400 feet up gradient from the off-site wells, they intercept water that would otherwise be captured by the off-site wells. To prevent dewatering, the total flow in this scenario was reduced to 395 gpm. The two off-site wells are pumped at 25 gpm and the southern-most well and pump test well are pumped at 50 gpm. The three wells along the west fence are pumped at 70 gpm. The northeast well is pumped at 35 gpm. Like the simulation shown for scenario 1, the duration of pumping is 5 years. In this scenario, the wells along the west boundary are intended to prevent any more contamination from leaving Dunn Field; reducing their number would allow contaminants to be pulled off-site.

The streamlines showing flow to these extraction wells are shown in Figure 7.4. The approximate zone of capture covers about 25 acres of Dunn Field west of the East Boundary, plus another 10 acres off-site. The zone of capture extends approximately



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- ● EXTRACTION WELL LOCATION
- ○ EXISTING MONITOR WELL

FIGURE 7.4
SCENARIO 2

400 200 0 400
SCALE IN FEET

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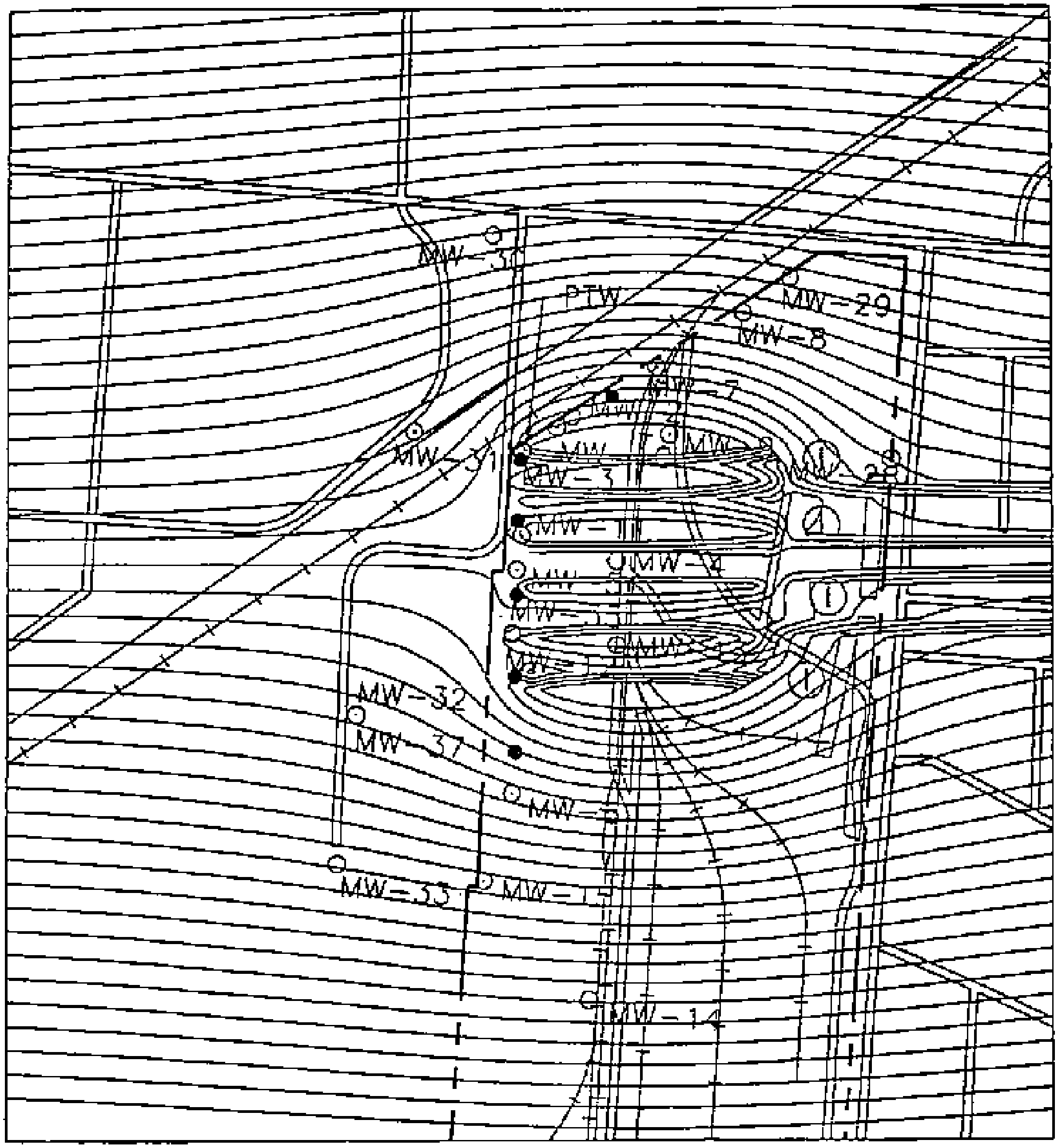
340 feet west of Dunn Field and approximately 130 feet north of the North Boundary of Dunn Field. The off-site influence in this scenario is less than Scenario 1 because less control is exerted north of Dunn Field. Because of the interference between the off-site and on-site wells, lower pumping rates are required to avoid dewatering the aquifer. These lower pumping rates affected all wells, and had the most effect on the off-site wells. As shown in Figure 7.4, the impact of the off-site wells is only a slight improvement over scenario 1.

7.4.3 Extraction and Reinjection Wells (Scenario 3)

Scenario 3 consists of six extraction wells and four reinjection wells. The six extraction wells are located within Dunn Field along the northern and western boundaries. Spacing of these wells is slightly greater than in scenarios 1 and 2. The four reinjection wells are located toward the east boundary of Dunn Field approximately 800 feet upgradient of the extraction wells. The reinjection wells could be located elsewhere, but placing them outside of the capture zone of the extraction wells eliminates opportunities to re-treat the ground water if a treatment system failure inadvertently introduced contaminants back into the aquifer. Locating them inside the capture zone allows effective control should a system failure occur.

The total pumping rate for the extraction wells is 360 gpm, divided equally between the six wells. At reinjection, this flow is distributed equally to the four wells. The proposed locations for these wells are shown in Figure 7.5, along with the streamlines of flow. In this scenario, the approximate zone of capture is 14 acres of Dunn Field west of the East Boundary, plus another 0.5 acres off-site. As before, the duration of pumping is 5 years.

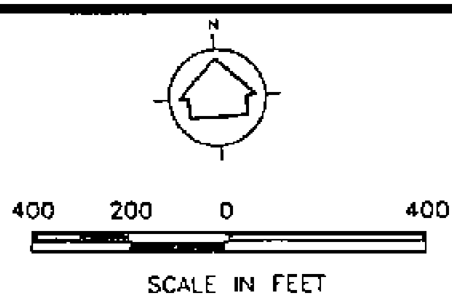
Pumping at higher rates increased the mounding effects around the reinjection wells, and increased the capture of clean ground water north and south of the contaminated zone.



LEGEND

- (I) INJECTION WELL LOCATION
- ● EXTRACTION WELL LOCATION
- ⊙ EXISTING MONITOR WELL

FIGURE 7.5
SCENARIO 3



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7.5 Comparison of Ground Water Control Scenarios

The three scenarios just described provide an useful contrast in strategies to control contaminated ground water beneath Dunn Field. The use of wells within Dunn Field (Scenario 1) appears to be a feasible and realistic approach to intercepting ground water contaminants.

Moving extraction wells to off-site locations (Scenario 2) where contaminants were found in 1990 somewhat increases the capture of off-site contaminants, but also adds some risk of pulling contaminants beneath Dunn Field off-site. Since the extent of contaminants off-site has not been determined, and because of the time that has elapsed since the 1990 sampling (allowing further migration), the location of off-site contaminants is uncertain. While off-site extraction wells may be part of an ultimate solution, more information on the extent of contamination and nature of pathways appears necessary before the best locations for off-site extraction wells can be determined.

The reinjection of treated ground water (Scenario 3) offers accelerated capture of contaminants beneath Dunn Field, at the expense of capturing more off site contaminants. With reinjection upgradient, contaminants in the Fluvial Aquifer beneath Dunn Field are pushed into the extraction wells, thereby cleaning up that portion of the aquifer more quickly.

7.6 Impacts of Pumping Scenarios

7.6.1 Impacts on Nearby Domestic or Production Wells

According to the Law Study report there are no domestic or production wells completed in the Fluvial Aquifer near the Dunn Field area. The nearest public water supply wells are in the Memphis Sand Aquifer at the Allen Well field owned by the Memphis Light, Gas, and Water Company. Other privately-owned water supply wells are screened in the Memphis Sand Aquifer, and are at some distance away. Although 500 gpm may be pumped from the Fluvial Aquifer at Dunn Field as part of the IRM, there would be no noticeable effect on the Memphis Sand Aquifer.

7.6.2 Impacts on Nearby Surface Water

The nearest surface water feature to Dunn Field is Cane Creek located 1,600 feet to the north of Dunn Field. The creek lies at an elevation above 240 feet mean sea level (MSL). The water level in the Fluvial Aquifer in Dunn Field is below this elevation (1990 Law), and the creek appears to be recharging the aquifer in the Dunn Field vicinity. The creek drops to 230 feet MSL some 4,000 feet west to Dunn Field, but the Fluvial aquifer at MW-31 (about 400 feet west of Dunn Field) is below 220 feet MSL. Therefore, Cane Creek appears to be losing water to the Fluvial Aquifer along most of its length upstream of its confluence with Nonconnah Creek (at an elevation around 205 ft MSL). Pumping in the Fluvial aquifer beneath Dunn Field would not affect the rate at which the creek recharges the aquifer (hydraulic gradients beneath the creek would be unchanged by pumping) and the reduction in the aquifer water levels would not change any discharge from the aquifer into the creek (it is not occurring in the Dunn Field vicinity).

7.6.3 Reinjection of Treated Water

Reinjection of treated water back into the Fluvial aquifer 800 feet upgradient of the extraction wells will create an artificial mound of ground water that will extend out approximately 500 feet in all directions from the reinjection wells (using the specific capacity and radius of influence derived from the pump test). Since the Fluvial aquifer is some 60 feet below the ground surface in the Dunn Field vicinity, and this mound will be less than 20 feet in thickness, this mound will not affect any surface activities, either in Dunn Field or elsewhere.

Since the State of Tennessee and Shelby County prohibit the injection of water into the aquifer as a means of protecting the public water supply, they would have to allow a variance to current regulations before this could occur.

8.0 DEVELOP/ASSEMBLE TECHNOLOGIES INTO ALTERNATIVES

The technologies which could be used to control ground water migration at Dunn Field were reviewed during the screening analysis described in Section 6.0. Those extraction, treatment, and disposal technologies which were retained are listed below.

A. Extraction
   1. Pumping Wells - On Site Only
   2. Pumping Wells - On and Off Site

B. Treatment
   1. Air Stripping for VOCs - Carbon Air Scrubber option
   2. UV/Oxidation for VOCs

C. Disposal
   1. Sanitary Sewer to POTW
   2. Surface Water Discharge
   3. Reinjection

Alternatives for controlling migration of ground water from Dunn Field can be formulated by selecting one technology and process option for each function (extraction, treatment, and disposal). The alternatives considered for the comparative analysis are presented in Table 8.1.

8.1 Alternative 1

This is the No Action Alternative. Selection of the no action Alternative at Dunn Field will be considered as a baseline comparison for the other six alternatives. With no action, the constituents of concern (VOCs) will continue to migrate downward into the Fluvial Aquifer from suspected but currently unidentified sources in Dunn Field. The Fluvial Aquifer will continue to receive these contaminants, and will transport them downgradient to the west. The concentration of these contaminants will diminish at greater distances from Dunn Field as mixing, adsorption and absorption occur. VOCs will be further diminished by chemical breakdown and naturally occurring biodegradation. The rate at which these process would occur in the Fluvial Aquifer is not known and cannot be predicted without further study. Furthermore, the distance

Table 8.1
Summary of Remedial Alternatives
Interim Remedial Measure for Ground Water
DDMT Dunn Field

Alternative	Extraction	Treatment	Disposal
1	No Action	none	none
2	Deep wells on-site	air stripping[1]	municipal sewer
3	Deep wells on- and off-site	air stripping[1]	municipal sewer
4	Deep wells on-site	UV/oxidation	municipal sewer
5	Deep wells on-site	air stripping[1]	surface drainage
6	Deep wells on-site	UV/oxidation	surface drainage
7	Deep wells on-site	air stripping[1]	reinjection up-gradient on-site

Source: ES, 1993.

[1]Note - Carbon adsorption option can be added to control air emissions of VOCs if required

and area off-site that would ultimately be affected by the constituents of concern cannot be predicted until further studies are performed.

8.2 Alternative 2

The ground water extraction system for Alternative 2 consists of eight wells located on Government property in Dunn Field. The approximate configuration of these eight wells is shown on Figure 7.3. The well locations were selected to extract ground water from the areas of the plumes shown on pages 3-14 and 3-15 to be most heavily contaminated. The average depth of the wells is estimated to be 80 feet each. Each well would be equipped with an individual submersible pump capable of pumping 75 gpm. Based on the models discussed in Section 7.3, eight wells pumping at rates between 30 and 75 gpm would create a capture zone of approximately 40 acres, including 12 acres outside the boundaries of Dunn Field.

Discharge from the eight wells would be directed to the 70,000 gallon holding tank constructed for the pumping test (1992 ES). The purpose of this tank would be twofold. First, it would provide flow equalization. Minimizing fluctuation in flow would improve performance and reduce the size of the treatment system. Second, the tank would provide sufficient detention time to allow any sediments to settle which might otherwise reduce the efficiency of the treatment system.

The extracted ground water would be pumped from the equalization tank to an air stripping tower for removal of volatile organic compounds (VOCs). Based on a flow rate of 520 gpm and the expected VOC concentrations shown in Table 8.2, an air stripping tower could be selected to achieve the Maximum Contaminant Levels (MCL) and the Maximum Contaminant Level Goals (MCLG). Table 8.2 shows both the highest VOC concentration in any monitoring well during the Law Study (1990 Law) as well as the expected concentrations from the eight extraction wells. Expected concentrations would be less than the maximum observed because water would be

Table 8.2
Expected Concentrations in Extracted Ground Water for Contaminants of Concern

Constituent	Concentration Highest (ppb)	Concentration Expected (ppb)	MCL or MCLG (ppb)	Percent Removal Required	Percent Removal Expected
Volatile Organic Chemicals					
1,1 dichloroethene	160	50	7	86	99
1,2 dichloroethene (total)	520	200	70	65	99
1,1,2,2 tetrachloroethane	1,900	200	n/a	n/a	90
tetrachloroethene	240	100	5	95	99
trichloroethene	5,100	350	5	98.6	99
carbon tetrachloride	77	8	5	38	99

Source: ES, 1993.

n/a Not Applicable
NR Not Required

withdrawn from several points across the plume and mixed together before treatment. The expected removal of VOCs is based upon their physical properties, and the expected removals in Table 8.2 are based upon a system removing 99 percent of trichloroethene.

Ground water would enter the air stripping unit at the top and flow by gravity downward while air is being blown into the bottom using a blower. The water would cascade over packing media which improves the transfer of VOCs to the air. An air stripping tower meeting the performance criteria in Table 8.2 could be readily procured for this application. The air stripper would be equipped with a control panel which would stop ground water pumping if the air stripper blower malfunctioned. Periodic cleaning of the packing media would be required to maintain the efficiency of the system.

Based upon the concentrations in Table 8.2, the extraction wells will produce approximately 2,910 pounds per year of VOCs (Table 8.3). The air stripping unit will transfer approximately 2,820 pounds/year (1,280 kg/yr) of VOCs into the atmosphere, and discharge about 90 pounds/year (41 kg/yr) into the water effluent. The greatest single constituent in the air emissions is trichloroethene with an annual load of 1,120 pounds/year (510 kg/yr). An air stripper equipped with a 1,000 scfm (standard cubic feet per minute) blower would emit trichloroethene at an average concentration of 34 micrograms per cubic meter (ug/m^3). The greatest single constituent in the water effluent would be 1,1,2,2 tetrachloroethane at a load of 64 lbs/yr (29 kg/yr), or an average concentration of 20 ug/L. There is currently no MCL for 1,1,2,2 tetrachloroethane.

Based on the Memphis-Shelby County Health Department air permitting requirements, purification of the exhaust would not be required. Sampling ports would be available on the air stripper to measure air emissions. If purification was determined necessary

Table 8.3
Summary of VOC Loadings to Air and Water
Alternative 2

VOC Constituent	Concentration Influent (ppb)	Total Load (lbs/yr)	Airborne Load (lbs/yr)	Water Load (lbs/yr)
1,1 dichloroethene	50	160	158	2
1,2 dichloroethene (total)	200	640	634	6
1,1,2,2 tetrachloroethane	200	640	576	64
tetrachloroethene	100	320	317	3
trichloroethene	350	1,120	1,109	11
carbon tetrachloride	8	26	25	1
Rounded Totals		2,910	2,820	90

Source: ES, 1993.

or desirable, the air stripper could be equipped with carbon adsorption units capable of removing greater than 99 percent of the VOCs from the air before exhausting it into the atmosphere. Regeneration of the spent carbon could be arranged through a vendor or it could be disposed of in a hazardous waste landfill.

Treated water would be conveyed to the sanitary sewer manhole located west of Dunn Field on Kyle Street. The sewer line at this location is 8-inch diameter ductile iron pipe. Due to the continuous addition of 520 gpm from the treated ground water, the sewer line would need to be upgraded to a 12-inch ductile iron or vitreous clay pipe. Pipe upgrades would have to continue downstream until a pipe capable of carrying current sewage plus the treated water was reached.

Sanitary sewage at Kyle Street is conveyed to the City of Memphis - South Wastewater Treatment Facility. This plant is designed for 80 million gallons per day (MGD), is currently operating at 65 MGD, and can easily accommodate the additional 0.75 MGD of treated ground water. The low concentration of VOCs and heavy metals in the treated ground water would not adversely effect the current operation of this facility. A sewer use charge would be assessed by the City of Memphis based on the quantity discharged to the POTW.

8.3 Alternative 3

The pumping and treatment system for Alternative 3 is identical to Alternative 2 except for the placement of extraction wells. Like Alternative 2, this alternative has eight extraction wells, but two of them are located west of Dunn Field downgradient from the property boundary. Alternative 3 provides greater capture of contaminated ground water off-site from Dunn Field. The extracted water would be pumped to Dunn Field for treatment by air stripping and conveyed to the POTW as described in Section 8.2.

The approximate configuration of the eight wells is shown on Figure 7.4. The locations were selected to create a line of extraction wells which would intercept the contaminant plume as it migrated off Government property as well as collect contaminated ground water further down gradient. Based on the models discussed in Section 7.4.2, eight wells pumping at 395 gpm would create a capture zone of approximately 32 acres, encompassing ground water beneath Dunn Field and to the north and west of Dunn Field.

Extraction wells operating off Government property would require easements, rights-of-way, or property acquisition from landholders. The security and integrity of these wells would have to be be maintained. Additional piping would be needed to convey the off-site ground water back to Government property for treatment.

8.4 Alternative 4

Alternative 4 would employ UV/oxidation to treat the ground water. The same ground water extraction and disposal configuration described for Alternative 2 in Section 8.2 would be used with Alternative 4. Ground water extracted on Government property would be treated using UV/oxidation prior to disposal to the POTW.

Extracted ground water would be conveyed to an ULTROX UV/oxidation treatment system or an approved equal. This process would use ultraviolet light, ozone and hydrogen peroxide to breakdown the VOCs into carbon dioxide, water and harmless inorganic chlorides. Parallel systems could be designed to remove greater than 99 percent of the VOCs from the ground water flowing through the process at a combined rate of 520 gpm. Components of the system would include a hydrogen peroxide feed tank and pump; air compressor and dryer; ozone generator, UV/oxidation reactor; and catalytic ozone decomposer. No contaminants would be released into the atmosphere.

For operation over a long period of time, the treatment process should be placed on a concrete pad. As a minimum, an enclosure would be constructed to house electrical equipment from the elements. The treatment process would be equipped with a control panel which would stop ground water pumping to the unit if the UV/oxidation system experienced a malfunction.

8.5 Alternative 5

Alternative 5 would extract ground water from Government property and treat it using air stripping as described in Section 8.2 for Alternative 2. The treated water from Alternative 5 would be conveyed to the natural storm water drainage for discharge.

Surface drainage channels exit from the north boundary and the west boundary of Dunn Field. Both convey runoff to Cane Creek located to the north, but the channel to the north of Dunn Field offers the shortest distance to Cane Creek, approximately 1,600 feet. This channel traverses a non-residential area between Dunn Field and Cane Creek. The channel is about 1.5 feet wide and 1 foot deep at the Dunn Field property line and has a capacity at that point of 20 cubic feet per second (cfs), which is sufficient to carry the continuous 520 gpm (1.16 cfs) being discharged from the treatment system. This flow would occupy the bottom of the channel and stay well within its banks.

A ridge exists between the anticipated location of the treatment system and the drainage ditch in the northeast corner of Dunn Field. To overcome this gradient, a force main would be constructed to the outfall using 10-inch PVC pipe. Discharge into Cane Creek would meet substantive NPDES requirements.

8.6 Alternative 6

Alternative 6 would extract ground water from Government property and treat it using UV/oxidation. The extraction scheme would be the same as the on-site wells in

Alternative 2. The treatment process would be the same as Alternative 4. The treated water would be conveyed to the surface drainage as in Alternative 5.

This alternative combines a more expensive treatment process, UV/oxidation, with a potentially less expensive water disposal strategy, discharge to surface drainage.

8.7 Alternative 7

Alternative 7 would extract ground water from six wells on Government property pumping at a rate of 360 gpm. The extracted water would be treated using air stripping as described in Section 8.2 for Alternative 2. The treated water from Alternative 7 would be reinjected directly into the Fluvial Aquifer up gradient from the extraction wells on Dunn Field.

Reinjection through four wells installed on the eastern side of Dunn Field would provide a controlled means of disposing of the treated ground water. The location of proposed reinjection wells is shown on Figure 7.5. The impact on ground water flow has been modeled and discussed in Section 7.4.3.

Pumps and piping would have to be installed to transmit the water from the treatment site to the east side of Dunn Field. Biological activity in the injection wells can foul screens and require periodic routine cleaning to maintain the desired recharge rates.

Chemically altered water is not normally allowed to be reinjected into the ground by the Memphis County Groundwater Quality Control Board of Shelby County. Under this alternative, the treated water would meet regulatory requirements for the constituents of concern in drinking water. Since it would be injected upgradient from the area of extraction, the treated water could be recaptured and treated again if undesirable constituents were introduced into the aquifer.

9.0 PERMIT CONSIDERATIONS

DDMT was added to the National Priorities List (NPL) in October 1992 (see 57 FR 47180, October 14, 1992), bringing DDMT under the jurisdiction of the federal Superfund (CERCLA) program. The U.S. EPA determined in the final rule [1985 NCP section 300.68 (a) (3)] that "Federal, State, and local permits are not required for Fund-financed action or remedial actions taken pursuant to Federal action under section 106 of CERCLA". The 1986 amendments to CERCLA implemented this section with a statutory provision, section 121 (e) (1), that provides that no Federal, State, or local permit shall be required for the portion of any removal, or remedial action conducted entirely on-site, where such remedial action is selected and carried out in compliance with Section 121. The reason for the permit exemption is to preserve flexibility and avoid lengthy, time-consuming procedures when developing and implementing remedial alternatives. Remedies selected must be protective of human health and the environment, and must meet substantive requirements under any Federal environmental law or more stringent State law that are identified as applicable or relevant and appropriate (1988 U.S. EPA). A copy of EPA's OSWER Directive 9355.7-03, Permits and Permit Equivalency Processes for CERCLA On-site Response Actions, is provided in Appendix G of this report.

The 1990 NCP [section 300.400 (e) (1)] clarifies this condition for "on-site" actions, defining "on-site" as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action". The preamble to the NCP (at 55 FR 8689, March 8, 1990) explains that "areal" refers both to the surface areas and the air above the site. EPA policy further defines "on-site" to include the soil and the ground water plume that are to be remediated.

While permits may not be required for CERCLA on-site response actions, some permitting authorities (Memphis-Shelby County Health Department Pollution Control and the Memphis-Shelby County Groundwater Quality Control Board) require lead agency participation in a process that is "equivalent" to a permitting process in spite of the EPA OSWER Directive found in Appendix G. In accordance with the OSWER Directive, DDMT should actively consult on a regular and frequent basis with the permitting authority to help hasten ARAR identification. To facilitate this arrangement, copies of submittals provided by the design contractor and the remedial action contractor would be submitted in a timely manner to the permitting authority whose ARARs are the subject of the submittals. However, any such agreement should be based on the understanding that a procedural "permit" or permit equivalency approval is not required, but that the lead agency (DDMT) is participating in the process in order to facilitate coordination and consultation with the permitting authority. Under a permit "equivalency" process the applicant would pursue a permit and the lead agency would waive most fees and public hearing requirements. This "equivalent" permitting process is conducted to satisfy the authority's concern that there will be compliance with ARARs. The permitting authorities argue that participation in a permit-like process is necessary to identify the substantive provisions of permitting regulations (1992 U.S. EPA).

Several "equivalent" or substantive actions are required to comply with the Memphis-Shelby County Health Department Pollution Control and the Memphis-Shelby County Groundwater Quality Control Board for direct on-site discharges and other on-site actions. Off-site discharges from Dunn Field directly to receiving waters, or indirectly to POTWs must comply with applicable and local substantive requirements and are not exempt from formal administrative permitting requirements. Under the Clean Water Act, operation of the preferred alternative would be considered to be a "direct" discharge. By EPA definition, direct discharge of wastewater is conside4ed to be on-site if the receiving water body is in the area of contamination or is in very close proximity to the site and is necessary for implementation of the response action (even if the water body flows off-site). The preferred alternative meets the criteria of on-site discharge, as the plant discharge will occur in the immediate proximity of the waste site (Dunn Field) and willbe directed to an existing drainage channel on-site. Thus, compliance with administrative ARARs is not required (August 1988 US EPA; August 1989 US EPA; and OSWER Directive 9234.1.02). Table 9.1 presents the actual permit requirements and the proposed "equivalent" or substantive requirements for the technologies which could be used to control ground water contamination beneath Dunn Field. Appendix D presents the permit application forms required for ground water treatment systems in Shelby County, Tennessee. The proposed "equivalency" permit submittal process and fees are described below for each alternative ground water system.

Ground Water Extraction Wells - A ground water treatment system could require the construction of six to eight extraction wells. A proposed "equivalency" well permit must be filed with the Memphis-Shelby County Health Department to meet administrative requirements. The proposed "equivalency" well permit is site specific and is valid for ninety days. An extension of three months can be requested before the proposed "equivalency" permit expires. The "equivalency" well permit fee is waived. (If an actual well permit is requested within ten days the cost is $125.00. If the permit is requested for a shorter time frame, less than 10 days the cost is $175.00).

TABLE 9.1

Permit Requirements for Ground Water Treatment Technologies

Technology	"Equivalent"* Construction Well Permit	"Equivalent"* Construction Air Quality Permit	"Equivalent"* Operating Air Quality Permit	City of Memphis Discharge Agreement (POTW)	"Equivalent"* NPDES Permit
Alternative 2 Air Stripper Treatment System (Extract on-site, POTW)	X	X	X	X	
Alternative 3 Pumps on/off site (Air Stripper Treatment, POTW)	X	X	X	X	
Alternative 4 UV/Oxidation Treatment System (Extract on-site, POTW)	X	X	X	X	
Alternative 5 Discharge to Surface Drainage (Extract on-site, air stripper treatment on-site, direct discharge to drainage channel)	X	X	X		X
Alternative 6 Discharge to Surface Drainage (Extract on-site, UV/oxidation treatment on-site, direct discharge to drainage channel)	X	X	X		X
Alternative 7 Ground Water Reinjection (Extract on-site, air stripper treatment)	Memphis-Shelby County Groundwater Quality Control Board prohibits reinjected ground water				

Source: ES, 1993.

* The permit "equivalency" process proposed by several state and local agencies is in direct conflict with the OSWER Directive provided in Appendix G of this report. This information is provided to reflect guidance issued by these agencies and does not reflect DDMT's intention to acquiese to these "permits-equivalent." DDMT will, however, comply with all substantive ARARs issued by these agencies during the design phase and will provide copies of design submittals for for the preferred alternative to the agencies for their review and comment.

Air Stripping and UV/Oxidation Treatment System An air stripping treatment system and a UV/Oxidation treatment system require the same substantive actions. The extracted ground water would be pumped through an air stripping unit (Alternatives 2, 3, 5 and 7). This process releases volatile organic compounds into the atmosphere and must meet all emission requirements. The Memphis-Shelby County Pollution Control Health Department requires an "equivalency" construction permit for the installation of a UV/Oxidation or air stripper treatment unit. The proposed "equivalency" construction permit involves submission of design specifications, identification of particulates emitted and an emission estimation for the treatment system. Based on air stripper and UV/Oxidation technology, there are no emission standards for VOCs and therefore each system is handled on an individual basis. If air emissions exceed 25 tons per year or more of particulate matter, the "best available control technology (BACT)" shall be utilized at the time of the proposed "equivalency" permit application. The emission rate and BACT requirements in Memphis-Shelby County for VOC sources are handled on a case by case basis. There are no minimum BACT requirements for VOC emissions, since Memphis-Shelby County is a nonattainment area for ozone.

Memphis Shelby County is a non-attainment area for ozone, which is regulated under the CAA in accordance with the National Ambient Air Quality Standards (NAAQS). Non-attainment area permits are issued under state or local jurisdiction. A CERCLA site would not be considered a major source unless its emissions equalled or exceeded 100 tons or more per year of the pollutant for which the area is designated non-attainment. Sources emitting a non-attainment pollutant must meet the lowest achievable emission rate.

The Memphis-Shelby County Pollution Department determines the type of VOC monitoring that is required for the treatment system. The Department has no fixed requirements for monitoring, and determines the frequency and monitoring parameters on a case by case basis. The "equivalency" permit fee is waived (the actual permit fee for a construction permit is $200.00). The time requirement for approval of the proposed "equivalency" construction permit is approximately 90 days or less. A proposed "equivalency" operating permit would be filed, once the proposed "equivalency" construction permit has been approved. The "equivalency" operating permit fee is waived (the actual permit fee is $50.00 per year), if the system emits less than twenty-five tons per year.

Based upon this information, the water treatment system will not require carbon adsorption units to purify air emissions, since the expected emission rate of 1.4 tons of VOCs per year falls well below the threshold for a major pollutant source.

Water Discharged to POTW. A discharge to a POTW is considered an off-site activity. Therefore, CERCLA responses are required to comply with substantive and procedural requirements of the national pretreatment program and all local pretreatment regulations before discharging wastewater to a POTW.

Treated water from Dunn Field would be conveyed to the sanitary sewer manhole located west of Dunn Field on Kyle Street. The sewer system at Kyle Street is directly conveyed to the City of Memphis South Treatment facility (also known as T.E. Maxon Facility). Discharging into the City of Memphis sewer system requires (Alternatives 2, 3 and 4) a written agreement with the city. The written agreement consists of identification of the constituents in the treated water and the amount of discharge to the city. In addition, there is a fee of $0.5868 cents per 1,000 gallons of treated water if the biological oxygen demand (BOD) is below 255 PPM and suspended solids are below 330 ppm. Additional charges could be rendered if BOD and suspended solids increase above these levels.

Water Discharged to Surface Water.

Treated water would be released into on-site surface water at a discharge point in the northern part of Dunn Field (Alternatives 5 and 6). Section 121(e) of CERCLA exempts any response action conducted on-site from having to obtain a Federal, State, or local permit. Under the Clean Water Act, discharge to surface drainage would be considered to a direct discharge. By EPA definition, direct discharge of wastewater is considered to be on-site if the receiving water body is in the area of contamination or is in very close proximity to the site and is necessary for implementation of the response action (even if the water body flows off-site) (August, 1988 USEPA; August, 1989 USEPA; and OSWER Directive 9234.1-02).

DDMT would file a proposed "equivalent" NPDES permit application to describe this discharge location, the continuous discharge rate and the constituent levels for the on-site treatment system in order to solicit substantive ARARS. However, the administrative requirement for either a permit or permit-equivalent would not be applicable because this will be an on-site discharge in accordance with OSWER Directive 9355.7-03.

Other Substantive Requirements

The NPDES permit program established other substantive requirements for the direct discharge of pollutants to surface waters that may be applicable or relevant and appropriate to circumstances at Dunn Field. These NPDES permit requirements are contained in 40 CFR Parts 122-125 and include:

Monitoring - As required in 40 CFR 122.44 (i), continued compliance with applicable NPDES discharge limitations is ensured through the establishment of monitoring requirements for the discharger. The regulation requires monitoring of the mass (or other specified measurement) of each pollutant regulated and the volume of effluent discharged from each point source. Other requirements include designation of monitoring points, monitoring frequency, sample types, and analytical methods. In addition to monitoring for regulated pollutant parameters, monitoring may be required for other pollutants of concern. These additional monitoring requirements are developed on a case-by-case basis.

Best Management Practices - In addition to standard discharge limits, best management practices (BMP) provisions can be required on a case-by-case basis (40 CFR 125.103(b)). These requirements can be incorporated into the NPDES permit and/or the CERCLA site decision documents.

Ground Water Reinjection Treatment System Memphis-Shelby County Groundwater Quality Control Board prohibits reinjected ground water. Section 13 of the Rules and Regulations promulgated by the Memphis County Groundwater Quality Control Board of Shelby County states "no injection wells of any type shall be allowed in Memphis and Shelby County for the injection of ground waters or chemically or thermally altered water into the underground formations. No well constructed shall be used for recharge, injection, or disposal purposes, no further consideration is given to this method." A copy of Section 13 of the Rules and Regulations have been included in Appendix D. A waiver for a reinjection system would be required from the Memphis-Shelby County Water Quality Control Board. This waiver would have to be accepted by EPA and the State of Tennessee. Frequent chemical testing of the reinjected water would be required to assure protection of the ground water supplies.

10.0 DETAILED ANALYSIS OF ALTERNATIVES

The alternatives developed and screened in Section 8.0 are subjected to a detailed analysis in this section. Nine criteria are used in this analysis, as mandated by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300.430(e)(9)). These criteria are as follows:

- Overall protection of human health and the environment;
- Compliance with applicable or relevant and appropriate requirements (ARARs);
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;
- State Acceptance; and
- Community Acceptance.

The considerations incorporated into these criteria are summarized in Table 10.1. The basis for defining the scope of these criteria comes from the Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (1988 EPA/540/G-89/004, OSWER). There is some overlap among these criteria, resulting in repetitiveness, but this overlap assures that all important aspects of each alternative have been considered.

10.1 Overall Protection of Human Health and the Environment

The No Action Alternative (Alternative 1) would provide no protection to human health and the environment other than that provided by natural attenuation, dilution, sorption, and limited biodegradation. The other alternatives (Alternatives 2-7) provide effective control of contaminated ground water beneath the northern portion of Dunn Field and beneath off-site land immediately north and west (down gradient). These alternatives are to minimize horizontal ground water migration in the Fluvial Aquifer, and intercept

TABLE 10.1

Description of Alternative Screening Criteria

Screening Criteria	Description of Criteria
Overall Protection Human Health and Environment	This criterion requires assessment of how each alternative, as a whole achieves and maintains protection of human health and the environment.
Compliance with ARARs	This criterion requires a description of how each alternative, will achieve ARARs. Included in this evaluation are chemical-specific, action-specific, and location-specific ARARs as well as other criteria, advisories, and guidelines to-be-considered.
Short-term Effectiveness	This criterion requires an evaluation of how human health and the environment will be protected during construction and implementation of the remedial alternative up until the time that response objectives are met. This includes protection of community and site workers and their associated environment.
Long-term Effectiveness and Permanence	This criterion requires an evaluation of how human health and the environment will be protected after response objectives have been met. This requires a comparison of the magnitude of residual risk and the adequacy and reliability of controls. Permanence is measured as the degree to which treatment is irreversible.
Reduction of Toxicity, Mobility, or Volume through Treatment	This criterion evaluates the anticipated performance of the specific process options that makeup each of the alternatives screened. Included in this evaluation is an estimation of the amounts of hazardous materials destroyed or treated and the types and quantities of residuals remaining after treatment.
Implementability	This criterion requires an evaluation of the technical and administrative feasibility of constructing and operating each alternative, including the availability of required goods and services (technologies, offsite TSD facilities, technical specialists). Also included here is an evaluation of the reliability of selected technologies, the ease of undertaking additional remedial measures if necessary, and the ability to obtain necessary permits and approvals.
Cost	This criterion is used to compare the capital and O&M costs associated with implementing each alternative. Present worth costs are summarized for each option using a 10 year period and an 8 percent discount rate scenario.
State Acceptance	This criterion requires an assessment of the State Regulatory Agency or support agency's preference among screened alternatives. This criterion will be addressed in concluding fashion in the Proposed Plan.
Community Acceptance	This criterion requires an assessment of the community's preferences for and concerns about selected alternatives. This criterion will be addressed in concluding fashion in the Proposed Plan.

Source: ES, 1993.

future releases of contaminants from Dunn Field as long as the extraction system is operated. These alternatives do not protect the Memphis Sand Aquifer down gradient from Dunn Field, other than by intercepting the contaminated portion of the Fluvial Aquifer before it migrates off-site. Furthermore, these alternatives do not protect the Memphis Sand Aquifer from vertical migration of comtaminants in areas where contamination already exists.

The treatment system employing UV/Oxidation (Alternatives 4 and 6) will destroy chlorinated solvents in the water, thereby preventing these toxic materials from harming the environment.

Air emissions from the alternatives employing air stripping (Alternatives 2, 3, 5 and 7) will transfer VOCs from the ground water into the atmosphere. The emissions into the atmosphere will not exceed risk limits to human health.

10.2 Compliance with ARARs

The No Action Alternative (Alternative 1) would provide no compliance with ARARs. The other alternatives (Alternatives 2-7) provide compliance with chemical-specific ARARs by removing VOCs from ground water beneath Dunn Field to levels below state and federal standards for drinking water. Other action-specific or location-specific ARARs have not been identified at this time.

The alternative providing reinjection (Alternative 7) of treated water back into the Fluvial Aquifer does not comply with State and County regulations prohibiting reinjection to protect the public water supply. A variance to this ARAR would be required from the State and County to allow reinjection.

10.3 Long-Term Effectiveness and Permanence

The alternatives involving ground water pumping (Alternatives 2-7) provide a partial solution to achieving long-term effectiveness and permanence. These alternatives are not permanent in that when the ground water extraction system is shut down, migration of contaminants in the Fluvial Aquifer away from Dunn Field resumes. A source-control action would be required to stop this migration before long-term effectiveness is achieved. Furthermore, the long term effectiveness of ground water pumping alternatives cannot be determined and verified without downgradient monitoring wells and definition of the groundwater plume.

10.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

The alternatives involving ground water pumping (Alternatives 2-7) provide effective control over the mobility of contaminants in ground water beneath the northern portion of Dunn Field and areas down gradient west of Dunn Field. The alternatives using UV/Oxidation for treatment (Alternatives 4 and 6) provide destruction of an estimated 1.4 tons per year of VOCs (see Table 8.3), thereby eliminating their toxicity and mobility, reducing their volume in the ground water environment, and preventing their dispersion into the atmosphere.

The alternatives employing air stripping (Alternatives 2, 3, 5 and 7) reduce the toxicity, mobility, and volume of contaminants in the ground water, but create a larger volume of air containing low levels of these contaminants that are below toxic risk limits.

10.5 Short-Term Effectiveness

With the alternatives involving ground water pumping (Alternatives 2-7), effective control of the ground water movement beneath Dunn Field and adjacent areas occurs within weeks after system startup. The community will experience negligible changes in protection during this period, since these alternatives do not control all contaminants in the Fluvial Aquifer downgradient. The short term effectiveness cannot be determined and verified without downgradient monitoring wells and definition of the groundwater plume.

With the reinjection alternative (Alternative 7), introducing treated water into the aquifer upgradient of the contaminated zone serves to accelerate the movement of contaminated ground water toward the extraction wells. While this action serves to hasten the cleanup beneath Dunn Field, it also reduces the influence of the extraction wells down gradient from Dunn Field.

10.6 Implementability

The alternatives using ground water extraction (Alternatives 2-7) would employ wells, piping, pumps, and many off-of-the-shelf other components that are widely available from many vendors.

The alternatives employing air stripping (Alternatives 2, 3, 5 and 7) utilize off-of-the-shelf systems that also can be procured from many vendors. The construction and erection of these components can easily be achieved using skills available in the local area. The UV/Oxidation treatment system (Alternatives 4 and 6) is a specialized system that is available from only a small number of vendors. The erection of this system would be performed using local skills and specialized supervision from the vendor.

The alternatives using the POTW for water-disposal (Alternatives 2, 3 and 4) will require state and local approval for discharge of treated water. Disposal of treated water into surface drainage (Alternatives 5 and 6) is an on-site discharge which must meet substantive NPDES requirements only. Disposal of treated water by reinjection (Alternative 7) will require a variance to the ground water protection regulations that prohibit reinjection.

Environmental monitoring of both air and water discharges would be required for alternatives using air stripping treatment (Alternatives 2, 3, 5 and 7). Monitoring of water discharges from the UV/oxidation system (Alternatives 4 and 6) would be required, but air monitoring would not be necessary.

Alternatives using POTW disposal (Alternatives 2, 3 and 4) will require the enlargement of sanitary sewers off-site, since current sewers adjacent to Dunn Field are not large enough to carry the new flow. Discharge rates into sewers could not be reduced without reducing the capture zone around the pumping wells. The distance for which sewer upgrades would be needed has been estimated at 2,000 linear feet to reach trunk sewers offering additional capacity. The POTW (the South Wastewater Treatment Plant) has sufficient capacity to handle the additional flow generated by the treatment system, and could accept the long-term discharge of treated water.

Construction of extraction wells, treatment units, piping, and other utilities will be restricted to the perimeter of Dunn Field to avoid interference with any potential source control actions at known burial trenches. Otherwise the locations of extraction wells are not critical, and well locations could be shifted 20 to 30 feet in any direction should obstacles be discovered during the design or construction process. Extraction wells will be installed along the fence, and connected by underground piping running along the fence. The ground water treatment system would be installed near the perimeter in an area known to be free of burial trenches. All discharge piping, electrical utilities, and service roads also can be located away from known burial areas. Nevertheless, contaminated soils may be encountered during construction of wells or pipe trenches, requiring special disposal of these soils.

Construction of extraction wells off-site (Alternative 3) would require negotiations with property owners to obtain easements for well locations, piping, and electrical service. If agreements cannot be reached with one owner, then negotiations would be needed with another owner, thereby extending the period to implement this alternative.

The extraction system could be expanded at some future date as more information is developed on ground water conditions away from Dunn Field. Additional extraction wells could be installed either on or off Government property, increasing the total flow of contaminated ground water. This flow could be treated in a new treatment unit located near those wells or piped to the unit serving the initial wells. Modifications at the initial treatment unit would be required if more capacity was needed. Disposal of treated water would increase to flow to the POTW or to surface drainage. If disposal was by reinjection, new reinjection wells would be required to accommodate flows from the new wells.

10.7 Cost

An evaluation of design, construction, and operation and maintenance costs has been performed for each of the alternatives. The No Action Alternative (Alternative 1) offers the least cost action, saving the construction and operational expenses associated with this action. The No Action Alternative carries a potential future cost for replacing community water supplies and managing the increased risk of disease and suffering associated with consumption of contaminated ground water.

The cost of installing extraction wells (Alternatives 2-7) is the same for all alternatives, except for the special features. The installation of wells off Government property (Alternative 3) will increase the costs of negotiating access and easements, but will not increase the cost of the wells themselves as long as the number of wells remains constant. The alternative providing reinjection (Alternative 7) has higher costs since more extraction wells spaced closer together are needed to insure that all constituents upgradient are captured. This alternative also requires injection wells to handle all treated flows.

The ground water treatment requirements for VOCs can be accomplished using air stripping (Alternatives 2, 3, 5 and 7), which is cheaper than UV/Oxidation

(Alternatives 4 and 6). The operation and maintenance cost for the air stripping equipment is less than the UV/Oxidation system.

The disposal of treated water to the POTW (Alternatives 2, 3 and 4) carries a sewer discharge fee that makes up 30 to 50 percent of the annual operation and maintenance costs. The disposal of treated water to surface drainage (Alternatives 5 and 6) offers the least cost, since there are no sewer use charges and other operation and maintenance costs are low. The alternative providing reinjection (Alternative 7) has higher costs since more labor will be needed periodically to clean the reinjection wells.

A summary of the capital and operation and maintenance costs are presented in Table 10.2. The net present value for each alternative is computed using a 10-year operating period and an 8 percent discount rate. The cost per 1,000 gallons is derived from the net present value, using the gallons pumped over the 10-year period as an estimate for the total pumpage. Any of the extraction alternatives (2 through 7) will achieve capture of contaminants initially in the ground water within a few years after startup, but continued operation of the system would be needed until a permanent solution is found to halt or intercept the contaminants migrating downward from the burial areas into the Fluvial aquifer. The 10-year operating period provides time to investigate these burial areas more thoroughly and develop a strategy for cleanup. Details for the cost estimates are presented in Appendix F.

10.8 State Acceptance

This section will be revised following State of Tennessee review and comment during the public comment period allowed for this document and for the Environmental Assessment document. Discussions with personnel from the State of Tennessee, Department of Environment and Conservation, resulted in the following preliminary findings: the State would accept alternatives which control migration of ground water

Table 10.2

Summary of Costs
Interim Remedial Measure for Ground Water
DDMT-Dunn Field

	Alternative	Capital Costs (1993 $)	Operation and Maintenance (1993 $)	Net Present Worth (1993 $)	Cost Per 000 gal (1993 $)
1	No Action	$0	$0	$0	$0
2	Extraction On-Site Air Stripping POTW	599,478	270,187	2,233,756	$0.817
3	Extraction On/Off-Site Air Stripping POTW	604,293	229,327	1,984,349	$0.956
4	Extraction On-Site UV/Oxidation POTW	825,248	303,487	2,649,696	$0.969
5	Extraction On-Site Air Stripping Surface Water	471,078	131,000	1,250,092	$0.457
6	Extraction On-Site UV/Oxidation Surface Water	659,398	163,500	1,626,386	$0.595
7	Extraction On-Site Air Stripping Reinjection	498,213	149,200	1,388,294	$0.734

Source: ES, 1993.

contaminants from beneath Dunn Field (Alternatives 2-6). The State would approve the alternative which provides destruction of the toxic constituents (Alternative 4) using treatment by UV/oxidation. The State would approve the discharge of treated water into the local POTW (Alternatives 2, 3 and 4), provided the POTW has accepted this discharge. The State would approve the discharge of treated water into surface drainage (Alternatives 5 and 6), provided proper sampling procedures documented dischargeable levels of contaminants after treatment and before discharge. The State would oppose reinjection of treated water (Alternative 7) because that action could adversely affect public water supplies if a process malfunction occurs.

10.9 Community Acceptance

This section will be revised following community review and comment during the public comment period allowed for this document and for the Environmental Assessment document. Based on experience at similar sites and professional judgement, the community would probably support alternatives which control migration of ground water contaminants from beneath Dunn Field (Alternatives 2-7). The community would probably approve the alternatives which provide practically complete destruction of the toxic constituents (Alternatives 4 and 6) using treatment by UV/Oxidation. The community would probably have reservations over the estimated 90 pounds per year of VOCs that would be discharged in water from an air stripping unit (Alternatives 2, 3, 5 and 7) even though all discharges meet substantive NPDES requirements. The community would probably have reservations over the discharge of treated water into the local POTW (Alternatives 2,3 and 4), but these reservations can be addressed through use of effective pre-treatment technologies before the water enters the sewer system. The community would probably also have reservations over the discharge of treated water into surface drainage (Alternatives 5 and 6), but these concerns can be addressed by using effective process controls, showing how small the flow is relative to natural runoff, showing the flow will remain entirely within the channel banks, and showing the discharge will have insignificant effects upon high water flows. The community will probably oppose reinjection of treated water (Alternative 7) because that action could adversely affect community water supplies if a process malfunction occurs and because that action is not permitted by current regulations. Because reinjection does not appear to offer technical advantages over the other options and because it creates community concerns, it does not warrant further consideration. A summary of these considerations is presented in Table 10.3.

TABLE 10.3
Detailed Analysis of Alternatives
(Page 1 of 4)

Evaluation Criterion	Alternative 1 No Action	Alternative 2 Extract on site Air Stripping POTW Disposal	Alternative 3 Pumps On/Off Site Air Stripping POTW Disposal	Alternative 4 Extract on site UV/oxidation POTW Disposal	Alternative 5 Extract on site Air Stripping Surf Drainage	Alternative 6 Extract on site UV/oxidation Surf Drainage	Alternative 7 Extract on site Air Stripping Re-Injection
Overall Protectiveness	Not Protective of Human Health and Environment	Controls VOCs beneath 40 acres of Dunn Field and down-gradient areas. Prevents horizontal migration of VOCs toward down-gradient areas. Does not protect Memphis Sand Aquifer down-gradient from Dunn Field from past releases.					
			Off-site wells add control over small area of down-gradient area.				
		Air emissions of 1.4 tons per year will not exceed risk limits	Air emissions of 1.4 tons per year will not exceed risk limits	VOCs destroyed by treatment process	Air emissions of 1.4 tons per year will not exceed risk limits	VOCs destroyed by treatment process	Air emissions of 1.4 tons per year will not exceed risk limits
Compliance with ARARs	None	Water Treatment process will produce an effluent meeting state and federal standards for VOCs. This is an interim remedy that is a partial solution until a final remedy can be designed and constructed.					
							Variance needed to local regulation against reinjection of "altered" water
Long-Term Effectiveness and Performance	None	Achieves remedial action objectives by controlling ground water near the source. Without a source-control action, this action is not an effective long-term solution. When this action is halted, off site migration of contaminants into the Fluvial Aquifer resumes. This action will not reduce the leaching and percolation of contaminants from the burial areas.					

TABLE 10.3
Detailed Analysis of Alternatives
(Page 2 of 4)

Evaluation Criterion	Alternative 1 No Action	Alternative 2 Extract on site Air Stripping POTW Disposal	Alternative 3 Pumps On/Off Site Air Stripping POTW Disposal	Alternative 4 Extract on site UV/oxidation POTW Disposal	Alternative 5 Extract on site Air Stripping Surf Drainage	Alternative 6 Extract on site UV/oxidation Surf Drainage	Alternative 7 Extract on site Air Stripping Re-Injection
Reduction of Toxicity, Mobility, and Volume	None	Mobility of ground water contaminants beneath Dunn Field completely controlled while system operates		Destruction of VOCs in groundwater offers permanent reduction of toxic compounds in the environment	Mobility of ground water contaminants beneath Dunn Field completely controlled while system operates	Destruction of VOCs in groundwater offers permanent reduction of toxic compounds in the environment	Mobility of ground water contaminants beneath Dunn Field completely controlled while system operates
		Toxic compounds transferred from ground-water into the atmosphere where dilution increases the contaminant volume		Volume of contami-nated groundwater is reduced Dilute emissions of toxic compounds into the atmosphere are eliminated	Toxic compounds transferred from ground water into the atmosphere	Volume of contami-nated ground water is reduced Dilute emissions of toxic compounds into the atmosphere are eliminated	Toxic compounds transferred from ground water into the atmosphere
Short-term	None	Controls contaminated ground water beneath Dunn Field and captures 40 acres of contaminated zone beneath Dunn Field and off site. Prevents further dispersion of contaminants into downgradient areas of Fluvial Aquifer while the system operates.					
							Reinjection up-gradient accelerates cleanup of contam-inated groundwater beneath Dunn Field, but reduces cleanup effectiveness off-site and down-gradient

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TABLE 10.3
Detailed Analysis of Alternatives
(Page 3 of 4)

Evaluation Criterion	Alternative 1 No Action	Alternative 2 Extract on site Air Stripping POTW Disposal	Alternative 3 Pumps On/Off Site Air Stripping POTW Disposal	Alternative 4 Extract on site UV/oxidation POTW Disposal	Alternative 5 Extract on site Air Stripping Surf Drainage	Alternative 6 Extract on site UV/oxidation Surf Drainage	Alternative 7 Extract on site Air Stripping Re-Injection
Implementability	None	Construction of extraction wells in Dunn Field, involves County permits, but has no other special considerations	Right of Way for wells and piping needed to bring water into Dunn Field for treatment	Construction of extraction wells in Dunn Field involves County permits, but has no other special considerations			
		Off the shelf components can be used for extraction wells, piping, air stripper, and other components. Equipment is available through multiple vendors, and can be installed by local contractors		Proprietary equipment required for UV treatment system. Equipment is available through few vendors. Local contractors not familiar with construction requirements	Off the shelf components used. Eqt is widely available and can be installed by local contractors	Proprietary equipment required for UV treatment system. Equip- is available through few vendors	Off the shelf components used. Eqt is widely available. and can be installed by local contractors Variance to regulations required
Cost	None	Capital Costs $599,478 O&M 270,187/yr	Capital Costs $604,293 O&M 229,327/yr	Capital Costs $825,248 O&M 303,487/yr	Capital Costs $471,078 O&M 131,000/yr	Capital Costs 659,398 O&M 163,500/yr	Capital Costs 498,213 O&M 149,200/yr
State Acceptance	Not Acceptable	---------------The State of Tennessee will accept protection of Memphis Sand Aquifer---------------					
		The State would accept the emission of 1.4 tons/yr VOCs. Carbon treatment of emissions might be required to meet BDAT in an ozone nonattainment area.		Destruction of VOCs is acceptable to state. Emission of gaseous residuals is acceptable.	same as 2 & 3	same as 4	same as 2 & 3

TABLE 10.3
Detailed Analysis of Alternatives
(Page 4 of 4)

Evaluation Criterion	Alternative 1 No Action	Alternative 2 Extract on site Air Stripping POTW Disposal	Alternative 3 Pumps On/Off Site Air Stripping POTW Disposal	Alternative 4 Extract on site UV/oxidation POTW Disposal	Alternative 5 Extract on site Air Stripping Surf Drainage	Alternative 6 Extract on site UV/oxidation Surf Drainage	Alternative 7 Extract on site Air Stripping Re-Injection
		The State would accept the disposal of treated water into the local POTW, provided the local POTW accepts this discharge.			Disposal of treated waters into surface drainage will require NPDES permit and periodic monitoring and reporting. Process upsets could impact surface water and draw state enforcement.		Re-injection violates local policy for protection of public water supply in Shelby County. Special variance would be required to allow this process.
Community Acceptance	Not Acceptable	Protection of Memphis Sand Aquifer is acceptable to community.	Off-site owners may not accept extraction wells on their property	---------Protection of Memphis Sand Aquifer is acceptable to community.----------			
		Emission of VOCs to air will create concerns for possible health risks or odors. Low concentrations will mitigate concerns.		VOCs are destroyed by treatment process	Same as 2 & 3	VOCs are destroyed by treatment process.	Same as 2 & 3
		Disposal of treated water into POTW would be acceptable if POTW accepts flow. Releases meeting MCLs will be fully achievable and acceptable.			Disposal into surface water creates concern within the community for surface water contamination, erosion and flooding. Discharge of 520 gpm (1.2 cfs) is acceptable in the community.		Disposal into Fluvial aquifer creates concerns over future ground water contamination due to process upsets

Source: ES, 1993.

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11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

1) The pump test conducted in the northwest corner of Dunn Field in September, 1992 revealed that the Fluvial Aquifer is relatively isotrophic and has a mean hydraulic conductivity of 6.91 x 10-2 feet/minute.

2) Ground water in the northwest corner of Dunn Field exhibited chlorinated solvents (classified as Volatile Organic Compounds or VOCs) during the September 1992 pump test, as it had during ground water sampling for the Law Study performed in 1989 and 1990. These VOCs are present in the Fluvial Aquifer above federal and state action levels.

3) Permit requirements for an IRM system would include an NPDES permit for discharge to surface water. Administrative requirements that would be met through an "equivalency" process include well drilling permits, air emission permits, water treatment plant construction and operation permits, and water discharge permits.

4) An IRM consisting of ground water extraction in Dunn Field appears to be an appropriate action at DDMT. Such a system would provide effective control in zones of highest VOC contamination and prevent migration off-site. This system would also provide some capture of off-site contaminants.

5) Technologies are available to implement an IRM at Dunn Field. Extraction using wells penetrating the Fluvial Aquifer is the most feasible control approach. Proven technologies for ground water treatment at the surface include air stripping, UV/oxidation and carbon adsorption. An IRM using these technologies

can be designed to provide environmental protection, operational flexibility and cost-effectiveness.

11.2 Recommendations

1) An Interim Remedial Measure (IRM) should be implemented to control VOC contamination in groundwater beneath the northwest corner of Dunn Field. Such a system would control ground water contamination in the vicinity of past burial trenches until more is known about the source and a permanent solution can be developed and implemented.

2) The recommended action is extraction within Dunn Field and treatment using air stripping, followed by discharge to surface drainage. This is Alternative 5 described in Section 8.5. Using this alternative, 520 gpm would be extracted from the Fluvial Aquifer using eight wells along the west and northwest boundaries of Dunn Field. This water would be treated using air stripping technology, which would emit about 1.4 tons per year of VOCs into the atmosphere. About 90 pounds per year of VOCs would be discharged to Cane Creek at extremely low levels that would not harm human health or the environment. This alternative is responsive to protecting human health and the environment, complying with ARARs, and is effective in the short-term. This alternative offers the fewest obstacles to implementation, is cost-effective, and appears to offer the best acceptance to the surrounding community.

12.0 REFERENCES

Bonn, B., and Rounds, S., *DREAM: Analytical Groundwater Flow Programs*, Lewis Publishers, Inc., 1990.

Driscoll, F.G., *Groundwater and Wells*, second edition, 1986.

Engineering-Science, Inc. *Pumping Test Technical Memorandum for Defense Distribution Region Central, Memphis, Tennessee*, St. Louis, MO November, 1992b.

Graham, D.D. and Parks, W.S., *Potential for leakage among principal aquifers in the Memphis Area, Tennessee*, U.S. Geological Survey Water Resources Investigation Report 85-4295, 1986.

Granger, R.A., *Fluid Mechanics*, Holt, Rinehart and Winston, 1985.

Jacob, C. E. , *Notes on Determining Permeability by Pumping Tests under Watertable Conditions*, U.S. Geological Survey, Open File Report, 1944.

Kearney, A.T., Inc., *R.F.A. Report Department of Defense Memphis Depot, Memphis, Tennessee*, January, 1990.

Law Environmental, Inc., Government Services Division, *Remedial Investigation/Feasibility Study (RI/FS) Revised Final Work Plans, Defense Depot Memphis, Tennessee*, Volumes I-V, April, 1989.

Law Environmental, Inc., Government Services Division, *Remedial Investigation Final Report Defense Depot Memphis, Tennessee*, August, 1990a.

Law Environmental, Inc., Government Services Division, *Final Feasibility Study Report Defense Depot Memphis, Tennessee*, September, 1990b.

McDonald, M.G., and A.W. Harbaugh, *A Modular Three-Dimensional Finite Difference Ground-Water Flow Model*, US Geological Survey, open file report 83-875, 1984.

Smith, J. W., and Z. Ishak-Muhamad. *Memphis Light, Gas and Water Department Water System Contigency Study*, Memphis State University, December, 1989.

US Army Environmental Health Agency (USAEHA), *Geohydrologic Study No. 38-26-0195-83, DDMT, Memphis, TN*, 21 June - 2 July 1982.

US Army Toxic and Hazardous Materials Agency (USATHMA), *Installation Assessment of Defense Depot, Memphis, Tennessee*, Aberdeen Proving Ground, Maryland, March 1981.

US EPA, *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual*, 540/1-89/002, December 1989.

US EPA, *CERCLA Compliance with Other Laws Manual: Draft Guidance*, EPA/540/G-89/006, August 8, 1988.

US EPA, *CERCLA Compliance with Other Laws Manual: Part II Clean Air Act and Other Environmental Statutes and State Requirements*, EPA/540/G-89/009, August 1989.

US EPA Memorandum, *Permits and Permit "Equivalency" Processes for CERCA On-Site Response Actions.* OSWER Directive 9355.7-03, February 19, 1992.

US EPA, Region IV, *RFI,Confirmatory Sampling and Interim Measures Work Plans, Defense Depot, Memphis TN*, Letter to DDMT Commander, August 14, 1991.

APPENDIX A

List of Agencies and Persons Consulted

Name and Title	Affiliation	Phone Number
Jordan English Supervisor of Superfund Programs	Tennessee Division of Superfund Field Office, Memphis	901/543-6695
John Leonard Water Pollution Control	Tennessee Division of Superfund Field Office, Memphis, Tennessee	901/543-6695
Greg Parker Supervisor of Water Quality Control	Memphis-Shelby County Health Department Water Quality Control	901/576-7741
Mac Parker Air Pollution Control	Memphis-Shelby County Health Department	901/576-7741
Barry Moore Water Pollution Control	Memphis-Shelby County Health Department	901/576-7741
John Yeganeh Air Pollution Control	Memphis-Shelby County Health Department	901/576-7653
Robert Foster Assistant Director of Water Supply	Tennessee Division of Water Supply, Nashville	615/532-0155
Ed O'Neil Manager of Water Supply	Tennessee Division of Water Supply, Memphis	901/423-6600
Clure Winfrey Administrator of Wastewater Collection Facilities	City of Memphis, Environmental Maintenance	901/528-2917
Al Chokhachi Environmental Engineer	Stiles Treatment Plant, Memphis, Tennessee	901/353-2392
Rodney Thomas	Stiles Treatment Plant, Memphis, Tennessee	901/353-2392

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: Jordan English
Tennessee Dept. of Superfund
Memphis, TN

Phone Number: (901) 543-6695 **Date:** 11-20-92 **Time:** 08:30 AM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Permits for Superfund Sites

Discussion:

Since DDRC is a superfund site, the initial permit process concerning time requirements for applications and fee do not apply. Superfund site permits are waived, but a letter and a completed permit application still must be submitted. If water is discharged offsite, and material is disposed offsite, then a permit for the offsite location is required.

The following contacts would be helpful for permit information:

Air Emission Permits: Contacts: John Yeganeh or Mac Parker
Memphis-Shelby County Health Department (901) 576-7741

Water Monitoring/ Drilling Permits Contacts: Greg Parker or Barry Moore
Memphis -Shelby County Health Department
(901) 576-7741

Off-Site Disposal, Solid Waste/ RCRA Permits Contact: Mark Thomas
Tennessee Division of Superfund
Department of Environmental Management
(901) 543-6695

NPDES Discharge Contact: John Leonard
Tennessee Division of Superfund
Department of Environmental Management
(901) 543-6695

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: Robert Foster
Assistant Director of Water Supply
Nashville, TN

Phone Number: (615) 532-0155 **Date:** 11-20-92 **Time:** 10:00 AM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Federal MCL's

Discussion:

Mr. Foster verified that the State of Tennessee Guidelines are equivalent to the Federal MCLs for drinking water.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: Greg Parker
Memphis-Shelby County Health Department
Memphis, TN

Phone Number: (901) 576-7741 **Date:** 11-25-92 **Time:** 11:30 AM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Water Well Permits

Discussion:

The Memphis-Shelby County Health Department requires a well permit for recovery wells or similar purposes. Mr. Parker will fax the Well Application Form.

The Department has a rule prohibiting reinjection wells. ES is considering an alternative that might use reinjection into the same formation. Mr. Parker explained that to date, variances to this rule have never been granted.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: Al Chockhachi
Public Works
Memphis, TN

Phone Number: (901) 353-2392 **Date:** 11-30-92 **Time:** 09:15 AM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Location of Sewer Lines

Discussion:

The location and diameter of the sewer lines located in the Dunn Field area are as follows:

Kyle Street, west side of DDRC, pipe has an 8 inch diameter line.

Hays Street has an 8 inch line which turns into a 10 inch line at Person Street.

A 36" diameter line is located south of the creek at Person and Regeon Street. A manhole is located near that intersection. The pipe goes northeast, along the creek and crosses the creek and ends up at Oaklawn Street.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: Clure Winfrey
Administrator of Wastewater Collection
Facilities, City of Memphis
Memphis, TN

Phone Number: (901) 528-2917 **Date:** 11-30-92 **Time:** 10:30 AM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Sewer Lines

Discussion:

Al Chockhachi, Pre-treatment Coordinator with Public Works, authorizes approval to hook up into the sewer system/line connected to the South Treatment Plant. (901) 353-2392.

NOTES OF TELEPHONE CONVERSATION

Phone Call From:	Bari Siegel Engineering-Science, Inc. St. Louis, MO 63017 (314) 576-7330
Phone Call To:	John Yeganeh Memphis-Shelby County Health Department Memphis, TN
Phone Number:	(901) 576-7741 **Date:** 12-09-92 **Time:** 10:30 AM
Project:	Defense Distribution Region Central Memphis, Tennessee Interim Remedial Measure for Ground Water SL016.22

Subject: Operating and Construction Permits

Discussion:

Memphis-Shelby County has adopted the State of Tennessee Air Code Regulations. The Code Number for an operating permit is:

Section 16-77 Reference 1200-3-9-.02

The Construction Permit Air Pollution Code Number:

Section 16-77 Reference 1200-3-9-.01

The Construction permit costs $200.00. The Operating permit costs $50.00 a year if the discharge is less than 25 tons per year. It takes 90 days or less for the permitting process to be approved.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: Al Chokhachi
Public Works
Memphis, TN

Phone Number: (901) 353-2392 **Date:** 12-15-92 **Time:** 1:45 PM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: South Treatment Plant

Discussion:

The South Treatment Plant, Memphis, Tennessee is currently handling 65 million gallons per day. The Plant has the capacity to treat up to 80 million gallons per day.

Volumetric Charge for disposal into the sanitary sewer:

a) $0.5868* cents per 1,000 gallons if:
   - BOD is below 255 ppm
   - Suspended solids are below 300 ppm

b) $0.5868 + $0.27 cents per pound if BOD is above 255ppm.

c) $0.5868 + .46 cents per pound if suspended solids are above 300 ppm

* includes no added treatment charge

A meter must be installed to record monthly volumetric discharge rates.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: John Yeganeh
Memphis-Shelby County Health Department
Memphis, TN

Phone Number: (901) 576-7741 **Date:** 12-17-92 **Time:** 09:30 AM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Air Emission Permits

Discussion:

The two treatment processes that are under consideration are the UV/Oxidation process and the Air Stripper unit. Both processes must file for a construction/operation permit. The state will decide if the UV/Oxidation would be exempt from the permit, based on the technology. Based on air stripper technology, there are no air quality standards for VOCs and therefore each unit/stripper is handled on a case by case basis. Each application is based on "Best Available Control Technology (BACT)".

The Air-quality Control Region of Memphis is Region #18. The status for the pollutants in the Memphis area is as follows. In October 1992, documents were sent to EPA Region IV to obtain approval for designating carbon monoxide at attainment levels for Memphis-Shelby County. These documents are currently under review by the EPA. In November 1992, documents were sent to EPA Region IV for review on the ozone levels for Memphis-Shelby County. EPA is currently reviewing the documents. Lead, ozone, and carbon monoxide levels for Memphis-Shelby County are currently at non-attainment levels until EPA approves the new application.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: John Yeganeh
Memphis-Shelby County Health Department
Memphis, TN

Phone Number: (901) 576-7741 **Date:** 6-8-93 **Time:** 02:30 PM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Air Emission Permits for Toxic Air Pollutants

Discussion:

The regulation for Toxic Air Pollutants is the State of Tennessee Air Pollution Code Section 16-81 Ref. 1200 3-11. The toxic air pollutants referenced are as follows:

Asbestos
Beryllium
Mercury
Vinyl Chloride
Benzene
Radionuclides
Inorganic Arsenic

At this time, Tennessee air regulations do not contain a Toxic Air Pollutant Clause for other VOCs. The State could possibly adopt such a clause by 1995.

The BACT requirement in Memphis-Shelby County for VOC sources is handled on a case by case basis. For a release of approximately 2 to 2.5 tons a year from an air stripper treatment system, there is no control requirement for BACT. The emission rate that BACT applies to is handled on a case by case basis.

The Memphis-Shelby County Health Department Pollution Control Section determines the type of VOC monitoring that is required for an Air Stripper or UV unit. For a discharge of approximately 2 to 2.5 tons per year, the monitoring could be daily, monthly, or every 6-months. Each discharge situation is handled on a site by site basis.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: John Leonard
Tennessee Division of Superfund
Memphis, TN

Phone Number: (901) 543-6695 **Date:** 06-14-93 **Time:** 09:30 AM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Amendments To An Existing NPDES Permit

Discussion:

The existing DDRC NPDES permit would need to be amended if:

a) an additional discharge point is added;

b) the type of water to be discharged is not covered in the existing permit. The current DDRC NPDES permit regulates stormwater and non-contact cooling discharges. Treated groundwater is considered process discharge, which is not included in the existing permit. Flow characteristics for the process discharge are required;

c) new parameters are to be discharged. This would also require new sampling criteria and total analysis. Additional monitoring requirements would be included.

The time requirement for amending the permit is approximately 90 to 100 days and could include public hearings. There is no fee to amend the current permit since there is an existing fee which is paid monthly.

If the current NPDES is to be amended, then a letter must be written, stating the changes to the existing permit and the reason for the changes.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: John Yeganeh
Memphis-Shelby County Health Department
Memphis, TN

Phone Number: (901) 576-7741 **Date:** 6-16-93 **Time:** 09:30 AM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Air Emission Permits

Discussion:

EPA is currently reviewing an application to redesignate Memphis-Shelby County as an attainment area for ozone. When an area is under reclassification the current State Implementation Plan (SIP) must be updated. The State of Tennessee SIP is in the process of revision.

While the SIP is under revision, ozone precursor requirements have been adopted by reference from the State of Tennessee Pollution Control Guidelines. The ozone precursor requirements are specified in Section 1200-3-18-.02 and state that a VOC is any organic compound which participates in atmospheric photochemical reactions. VOCs that do not participate in atmospheric photochemical reactions are labeled nonreactive organic compounds.

NOTES OF TELEPHONE CONVERSATION

Phone Call From: Bari Siegel
Engineering-Science, Inc.
St. Louis, MO 63017
(314) 576-7330

Phone Call To: Al Chokhachi/ Pre-treatment Coordinator
Public Works
Memphis, TN

Phone Number: (901) 353-2392 **Date:** 6-17-93 **Time:** 03:00 PM

Project: Defense Distribution Region Central
Memphis, Tennessee
Interim Remedial Measure for Ground Water
SL016.22

Subject: Water Discharge/South Treatment System

Discussion:

The water discharged into the sewer system at DDRC is metered through Memphis Light and Gas. To obtain the sewer rate charge per month at DDRC, call the Sewer Fee Department in Memphis with the DDRC sewer account number.

Approximately 70,000 gallons of waste water (water from the pump test 8/92) at Dunn Field will be discharged to the South Treatment Plant also called the T.E. Maxon Facility. A fee of $0.5868 cents per 1,000 gallons of waste water will be charged to DDRC.

APPENDIX B

MEMPHIS-SHELBY COUNTY AIR POLLUTION CONTROL GUIDELINES

SECTION 1200-3-18-.02

1200-3-18-.02 DEFINITIONS

(1) Unless specifically defined in this Chapter, the definitions from 1200-3-2 will apply:

(a) "Volatile Organic Compound (VOC)" means any organic compound which participates in atmospheric photochemical reactions. VOC may be measure by a reference method, an equivalent method, an alternative method, or by procedures specified under 40 CFR Part 60 (revised as of July 1, 1990). A reference method, an equivalent method, or an alternative method, however may also measure nonreactive compounds. In such cases, an owner or operator may exclude the nonreactive organic compounds when determining compliance with a standard. The following compounds will not be considered volatile organic compounds:

Methane
Ethane
Methylene chloride
Methyl chloroform (1,1,1-trichloroethane)
Trichlorofluoromethane (CFC-11)
Dichlorofluoromethane (CFC-12)
Chlorodifluoromethane (CFC-22)
Trifluorometnane (FC-23)
Trichlorotrifluoroethane (CFC-113)
Dichlorotetrafluoroethane (CFC-114)
Chloropentafluoroethane (CFC-115)
Dichlorotrifluoroethane (HCFC-123)
Tetrafluoroethane (HCFC-134a)
Dichlorofluoroethane (HCFC-141b)
Chlorodifluoroethane (HCFC-142b)
2-Chloro-1,1,1,2 - Tetrafluoroethane (HCFC-124)
Pentafluoroethane (HFC-125)
1,1,2,2 - Tetrafluoroethane (HFC-134)
1,1,1 - Trifluorethane (HFC-143a)
1,1 - Difluorethane (HFC-152a)

Perfluorocarbon compounds in the following four classes:

Cyclic, branched, or linear, completely fluorinated alkanes
Cyclic, branched, or linear, completely fluorinated ethers with no unsaturations
Cyclic, branched, or linear, completely fluorinated tertiary amines with no unsaturations
Sulfur containing perfluorocarbons with no unsaturations and with sulfur bonds only to carbon and fluorine

(b) "Exempt solvent" means any compound that is exempted under the definition of "Volatile Organic Compound (VOC)"

APPENDIX C

FEBRUARY 5, 1991. LETTER SENT TO THE GOVERNOR OF TENNESSEE FROM THE REGIONAL ADMINISTRATOR OF EPA REGION IV

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY FEB - 8 1991

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

66 151

FEB 5 1991

4APT/APB

Honorable Ned McWherter
Governor of Tennessee
State Capitol
Nashville, Tennessee 37219

Dear Governor McWherter:

To follow up the letter to you from Assistant Administrator William G. Rosenberg, dated December 13, 1990, concerning the Clean Air Act Amendments (CAAA) of 1990, I want to describe several specific State actions that must be completed or started soon to implement the nonattainment provisions of Title I. Some of these actions are associated with especially short schedules.

Over the next few weeks and months, each State must define its nonattainment areas and begin the development and adoption of new controls in accordance with the Amendments. The Environmental Protection Agency (EPA), while developing and implementing new control initiatives at the national level, will support your State efforts by providing a number of guidance materials and conducting a series of workshops on selected topics. The Regional Office will continue to work directly with your State air agency director and staff to communicate the new requirements and the guidance and other assistance to be provided by EPA.

The following paragraphs discuss in detail various Title I requirements that apply to ozone, carbon monoxide (CO), sulfur dioxide (SO_2), and lead air pollutants. The discussion will include both areas designated nonattainment at the time of enactment and new areas.

I. Designations/Classifications/Boundary Determinations

The letter from Assistant Administrator William G. Rosenberg to you, dated December 13, 1990, (Assistant Administrator Letter) described in a general fashion the State actions that will be needed to determine the designations, classifications, and boundary determinations for areas in your State. This letter will describe those actions in more detail, and provide a blueprint for specific actions you need to take with respect to your areas.

appropriate modifications) no later than 240 days from

A. Ozone and CO Areas

1. Overview

In general, the 1990 CAAA require each State to submit to EPA by March 15, 1991, (120 days after enactment), a list of all areas in the State, indicating designations (attainment, nonattainment, or unclassifiable) for ozone or CO (or affirming existing designations) and describing their boundaries. It is not lawful, through this process, to reduce any existing boundaries of ozone or CO nonattainment areas, and thereby redesignate an area from nonattainment to attainment. EPA intends to act on the list by promulgating new or affirmed designations, classifications, and boundaries by no later than July 13, 1991 (no later than 120 days after receipt of the State list is required). If EPA chooses to modify the State list (including, for example, modify the boundaries), EPA must notify the State by no later than May 14, 1991 (60 days prior to EPA promulgation).

EPA interprets the new Act to require two basic procedures for designating, classifying, and determining the boundaries for ozone and CO areas. First, as of the date of enactment, designations occurred by operation of law on the basis of current designations. In other words, areas formally designated as nonattainment before enactment were again designated as nonattainment by operation of law. In addition, areas that were designated nonattainment upon enactment were classified at that time on the basis of 1987-89 data, in the case of ozone, and 1988-89 data, in the case of CO. These classifications, in turn, triggered (i) the 45-day metropolitan statistical area (MSA)/consolidated metropolitan statistical area (CMSA) process described in the Assistant Administrator Letter for ozone and CO nonattainment areas that were classified upon enactment as serious, severe, or extreme; (ii) the 90-day opportunity for the Administrator to consider adjusting the classification for nonattainment areas under the 5 percent provision; and (iii) the requirement for submission of corrections to current State rules representing reasonably available control technologies (RACT) in ozone nonattainment areas by May 15, 1991.

Second, additional designations, classifications, and boundary-setting will occur through the State submission of a list of areas in the State at 120 days from enactment (March 15, 1991), and EPA promulgation of that list (with appropriate modifications) no later than 240 days from enactment (July 13, 1991). This 240-day process may result in the addition of new nonattainment designations for some areas not previously designated nonattainment, and the expansion of the boundaries of some areas that were designated nonattainment as of the date of enactment. Areas newly designated to nonattainment at this 240-day process will be classified, and their classification will in turn trigger (i) the 45-day process described in the Assistant Administrator Letter for ozone or CO nonattainment areas classified as serious, severe, or extreme; and (ii) the 90-day opportunity for the Administrator to consider adjusting the classification for ozone nonattainment areas under the 5 percent provision.

2. Requirements for Specific Areas

a. Pre-enactment Nonattainment Areas

Under the 1990 CAAA, as of the date of enactment (November 15, 1990), Memphis and Nashville were designated nonattainment for ozone and Memphis was designated nonattainment for CO by operation of law. These are areas designated nonattainment under 40 CFR part 81 (the designation tables). In addition, each area became classified in accordance with 1987-89 air quality data for ozone, and 1988-89 data for CO.

The following table identifies each pre-enactment ozone and/or CO nonattainment area in your State, its relevant air quality data, and its classification as of the date of enactment:

Table 1: Ozone

Name of Area	1987-89 Design Value	Classification
* Memphis	0.140	Moderate
Nashville	0.138	Moderate

66 154

Table 2: CO

Name of Area	1988-89 Design Value	Classification
* Memphis	9.6	Moderate

As indicated in tables 1 and 2, the Memphis and Nashville areas were classified, as of the date of enactment, as marginal or moderate for ozone, and the Memphis area was classified as moderate for CO. As previously stated, the State is required to submit a list of all ozone and/or CO areas in the State, designating them and describing their boundaries by March 15, 1991. EPA will promulgate the list by no later than July 13, 1991. In determining the boundaries, the State should consider a wide range of factors, including population, population density, growth patterns, commuting patterns, commercial development, industrial development, topographic and meteorological conditions, and pollution or precursor transport in defining the boundaries. The default area for boundaries for ozone and CO nonattainment areas should be the MSA/CMSA.

As indicated in the Assistant Administrator Letter, if the design value of any of your ozone (and/or CO) areas is within 5% of the cut-off for another (higher or lower) classification, your State may request that the area be reclassified to the other classification. A December 19, 1990, letter has been received from your State air director requesting that both Memphis and Nashville be reclassified as marginal ozone nonattainment areas. The Agency will be evaluating a number of criteria including 1990 air quality data, air quality trends, growth projections, and emission trends in making its final decision on the Memphis and Nashville classifications. EPA must make any such reclassification by February 13, 1991. We will evaluate your request and, shortly after February 13, 1991, notify you of the decision.

b. Areas Not Designated Nonattainment as of the Date of Enactment

Tennessee has the Knoxville ozone area, no portion of which was designated nonattainment prior to the enactment of the 1990 CAAA. EPA expects that the following new area will be designated nonattainment and classified based on the relevant air quality data:

Table 3: Ozone

Name of Area	1987-89 Design Value	Classification
Knoxville	0.135	Marginal

As previously indicated, the State is required to submit a list of all ozone and/or CO areas in the State, designating them and describing their boundaries by March 15, 1991. EPA will promulgate the list by no later than July 13, 1991. In determining the boundaries, the State should consider a wide range of factors, including population, population density, growth patterns, commuting patterns, commercial development, industrial development, topographic and meteorological conditions, and pollution or precursor transport in defining the boundaries. The default area for boundaries for ozone and CO nonattainment areas should be the MSA/CMSA.

Additionally, it should be noted that Smyth County, Virginia, which is adjacent to the Johnson City, Tennessee, MSA, has monitored violations of the ambient air quality standard for ozone and will likely be redesignated to nonattainment. Since Smyth County is rural, possible transport contribution to the monitored violations is being evaluated. Should that evaluation indicate that the Johnson City area is contributing to these violations, the nonattainment area could be expanded to include all or part of the MSA. EPA will ensure that the State air agency is kept informed of any pertinent developments regarding this issue.

B. Sulfur Dioxide Areas

1. Designations and Boundaries

In 1971, when EPA promulgated the ambient SO_2 standards, it designated areas nonattainment, attainment, or unclassifiable. Any area in your State designated as not attaining the SO_2 standard as of the date of enactment of the 1990 CAAA (November 15, 1990) is designated by operation of law as a nonattainment area under the 1990 CAAA. The following lists the counties in your State which are nonattainment areas:

<u>Area</u>

Benton and Humphreys Counties (TVA New Johnsonville)

Polk County

Section 107 of the CAAA, requires the State to submit SO_2 designations 120 days from date of notification by EPA. However, I encourage you to submit your designations for these areas by March 15, 1991, along with the submittal for ozone. If you submit them within this period, EPA will make every effort to promulgate combined designations by July 13, 1991. In any event, I am requesting that you submit your designations not later than 116 days from the date of this letter.

2. <u>Sulfur Dioxide SIP Requirements</u>

For any areas in your State designated as nonattainment as of the date of enactment for SO_2, but lacking a fully approved plan, the State must submit a SIP to EPA within 18 months of the date of enactment. For these existing nonattainment areas, this requires revising the SIP to include additional controls as needed to provide for attainment. To develop and implement these controls, a number of important activities must be completed or started to meet the 18-month from the date of enactment requirement specified in the legislation. For example, actions must be initiated quickly to collect pollutant emissions data, conduct air quality modeling, and adopt specified control measures. The SIP must provide for attainment of the SO_2 standard as expeditiously as practicable but no later than five years from the date of enactment.

Both of the existing SO_2 nonattainment areas do have fully approved plans. However, there are indications that there may have been recent violations of the SO_2 standard in the Polk County area. The data is currently undergoing evaluation which may result in a requirement for the State to submit a revised plan for that area.

The above-mentioned SIP must meet all Clean Air Act requirements for implementation plans identified in section 172(c) of the CAAA, and 40 CFR Part 51. Guidance on these requirements was previously provided to your State Air Division (Sulfur Dioxide - EPA-450/2-89-019). These plan requirements include, but are not limited to, the implementation of all reasonably available control measures needed for attainment, provisions for reasonable further progress, completion of an emissions inventory, provisions for the permitting of new or modified sources which meet the requirements of section 173, and compliance with the additional requirements of section 110(a)(2) of the CAA, as amended.

C. Lead Areas

1. Designations and Boundaries

In 1978, when EPA promulgated the ambient lead standard, it was not authorized to classify areas nonattainment, attainment, or unclassifiable. Under section 107(d)(5) of the CAAA, EPA is now authorized to require the State to designate areas in the State as nonattainment, attainment, or unclassifiable for lead.

Based upon the available information, EPA believes the following areas should be designated as indicated below:

Area	Designation
Shelby County	Nonattainment
Williamson County	Nonattainment
Fayette County	Unclassifiable

This determination is based on the ambient air monitoring data contained in an enclosed table entitled "Tennessee Lead NAAQS exceedances for 1988 AND 1989." Please consider the data contained in that table prior to submitting your designations to EPA. There is not sufficient quality assured ambient air data to determine the attainment status of Fayette County. Once adequate data is obtained, the attainment status for Fayette County will be reevaluated. Further guidance on determining specific boundaries is being provided to the State air director. Section 107(d)(1) and (d)(5) of the CAAA, permits EPA to require the State to submit lead designations as EPA may deem reasonable, but no sooner than 120 days from the date of notification. I encourage you to submit your designations for these areas by March 15, 1991, along with the submittal for ozone and CO. If you submit them within this period, EPA will make every effort to promulgate combined designations by July 13, 1991. In any event, I am requiring that you submit your designations not later than 120 days from the date of this letter.

2. Lead SIP Requirements

Any State containing an area designated as nonattainment for lead must submit a SIP to EPA within 18 months of the nonattainment designation. The SIP must provide for attainment of the lead standard as expeditiously as practicable, but no later than five years from the date of the nonattainment designation. EPA intends to complete the nonattainment designations in the third quarter (calendar) of 1991. Therefore, we expect that lead SIPs will be due in the first quarter (calendar) of 1993. Attainment dates, for these nonattainment areas, should be no later than the third quarter (calendar) of 1996.

The above mentioned SIP must meet all the requirements for implementation plans identified in section 172(c) of the CAAA, and 40 CFR part 51. These plan requirements include, but are not limited to, the implementation of all reasonably available control measures needed for attainment, provisions for reasonable further progress, provisions for the permitting of new or modified sources which meet the requirements of section 173, and compliance with the additional requirements of section 110(a)(2) of the CAAA.

II. Outstanding SIP Calls (Notices of SIP Inadequacy)

As you may recall, on May 26, 1988, and November 8, 1989, I notified you by letter that the SIPs for the areas listed in Tables 1 and 3 were substantially inadequate to provide for timely attainment of the relevant NAAQS under section 110(a)(2)(H) of the Clean Air Act. EPA stated that Kentucky should respond in two phases to produce SIPS that would be adequate to attain and maintain the standards. Phase I asked you, among other things to update your emission inventories and make corrections in regulations imposing RACT on existing stationary sources. (See discussion below concerning RACT corrections.) Phase II would include a full attainment demonstration with supporting regulations. You were advised that you could delay submitting Phase

II until EPA completed its policy on post-1987 nonattainment planning. Although the post-1987 policy was never finalized, the CAAA of 1990 prescribe a new schedule for submitting attainment demonstrations and regulations. The requirements and schedule for the Phase II SIP-calls are now provided in the new law.

The Assistant Administrator's Letter stressed the importance of reviewing current State rules and procedures to ensure that they were consistent with national policies and guidance and that maximum benefit was being derived from the existing air pollution control program. This step would also ensure that a solid foundation was established for subsequent rule development and adoption. The focus of this effort would be correcting RACT rules in accordance with previous notifications and correcting motor vehicle inspection and maintenance (I/M) programs where necessary.

A. <u>RACT Corrections</u>

On May 26, 1988, and on November 8, 1989, I notified you that specific action was needed to correct deficiencies in the Tennessee regulations representing RACT for sources of volatile organic compounds (VOC). A list of those deficiencies has been provided to your State air agency. My staff is presently coordinating with your State air agency staff to complete the required corrections. I encourage you to make the necessary corrections to the RACT rules as soon as possible. The 1990 CAAA require that these corrections must be completed and submitted to EPA no later than May 15, 1991.

B. <u>I/M Corrections</u>

The 1990 CAAA require states that were required to or have already implemented I/M programs to submit an immediate SIP revision providing for measures to correct deficiencies that may exist in these programs. As a result of an audit on May 14-16, 1990, the I/M program in Memphis appears not to be in compliance with either the commitments in the SIP or with EPA's minimum program requirements. Thus, it is likely that corrections to the Memphis program will be necessary.

The I/M program in Nashville is currently meeting the commitments contained in the 1982 SIP revisions and EPA's current policy requirements. The CAAA of 1990 require EPA to revisit and republish I/M policy, however, which may result in the need for SIP revisions to meet any new requirements.

EPA will be confirming its assessment of the Memphis and Nashville program designs and performance and revisiting the specific policy requirements for basic and enhanced I/M programs, in consultation with state and local officials and other interested parties. This work will be completed as quickly as possible. We will forward the updated requirements to you as soon as they are completed. In the meantime, in order to comply with the spirit of the law, I ask that you make a formal commitment in writing by the end of February to pursue corrections to the programs according to the terms of the new policy, once the policy is issued. My staff will be ready to assist yours in developing the specific changes that will be necessary.

III. Pending Redesignation Requests

With respect to your pending section 107 redesignation requests for Polk County and the New Johnsonville areas for SO_2, I fully recognize that EPA has not completed action on your submittals. However, new provisions in the amended Act modify what states need to submit in their redesignation requests and supply new requirements that must be met before EPA may approve the request. The amendments bar redesignation under the present circumstances because Tennessee has not met these requirements.

Specifically, under the amended Act, EPA is obligated to approve or disapprove a State redesignation submittal within eighteen months of the agency's receipt of a complete submittal [section 107(d)(3)(D)]. The amendments prohibit EPA from approving a redesignation request that does not demonstrate that: (1) the area has attained the NAAQS; (2) EPA has fully approved the SIP; (3) the area's improvement in air quality is due to permanent and enforceable emission reductions resulting from implementation of the SIP; (4) the State has submitted and EPA has approved a maintenance plan meeting the requirements of section 175A; and (5) the State has met all the requirements applicable to the area under section 110 and Part D.

In light of these prerequisites to EPA approval, EPA is hereby notifying Tennessee that its redesignation requests for those areas are incomplete. At a minimum, the requests lack a ten-year maintenance plan for either area, as described in section 175A. In addition, with respect to the Polk County request, as previously mentioned there may have been recent violations of the SO_2 standard. Until the review of the data is complete, we cannot advise you as to the specific changes which may be required for that area. With respect to the request for the New Johnsonville area, it was not processed due to the Stack Height Remand. My staff will be working with your State air agency staff to determine what will be needed to finalize the redesignation.

IV. EPA Guidance Materials

The EPA has developed a number of guidance materials to support States as they revise their SIPs. Enclosed is a list of currently available and planned guidance. One document listed, "Getting Started on the Title I Requirements," will provide an overview of the early State submittal requirements and a summary of the related guidance to be provided by EPA. We will keep your State air director apprised of other support activities, such as national workshops on selected topics and issues.

I am sure you will agree that the Clean Air Act Amendments have presented a substantial challenge to State and Federal agencies and officials responsible for implementing the many new provisions. This challenge also comes with a unique opportunity to achieve some of the nation's most difficult air quality goals that, despite the broad range of formidable efforts of the past, have remained beyond our grasp. I look forward to continuing the strong, cooperative relationship between your State and EPA as we face these exciting new challenges and opportunities.

Sincerely yours,

Greer C. Tidwell
Regional Administrator

Enclosures

cc: Harold Hodges
Paul Dontrager
Terry Harris
Dennis Fritchie

TENNESSEE LEAD NAAQS EXCEEDANCES FOR 1988 AND 1989.

values are in ug/m^3

	1st quarter	2nd quarter	3rd quarter	4th quarter
Shelby County				
	Monitor # 47-157-0044			
1989	*----	----	----	4.42
Williamson County				
	Monitor # 47-187-0102			
1988	0.66	1.25	1.61	0.54
	Monitor # 47-187-1101			
1988	1.15	1.68	1.97	1.42

* no data available

APPENDIX D

PERMIT FORMS AND REQUIREMENTS

Permit Forms and Requirements

1. Well Application Form

2. Construction and Operating Air Control Application

3. NPDES "Application for Permit to Discharge Process Wastewater"

4. City of Memphis, Division of Public Works "Industrial Wastewater Discharge Permit" Application

5. Rules of "Tennessee Department of Health and Environment Bureau of Environment Division of Air Pollution Control" Chapter 1200-3-9 Construction and Operating Permits

6. Section 13 of "Rules and Regulations - Memphis County Groundwater Quality Control Board of Shelby County"

7. Section 6 of "Rules and Regulations - Memphis County Groundwater Quality Control Board of Shelby County"

WELL APPLICATION FORM

HEALTH DEPARTMENT
POLLUTION CONTROL SECTION
WATER QUALITY ROOM 438-L
814 JEFFERSON AVENUE
MEMPHIS, TN 38105
901-576-7741

WELL APPLICATION FORM

SECTIONS I, II, III, AND IX MUST BE COMPLETELY FILLED OUT BY THE WELL OWNER. SECTIONS IV THRU VIII MUST BE COMPLETELY FILLED OUT BY THE WELL DRILLER. APPLICANT AND DRILLER MUST SIGN APPLICATION.

I. WELL OWNER

NAME OR NAME OF ESTABLISHMENT: ____________________

CONTACT NAME: ____________________ TITLE: __________

MAILING ADDRESS: ____________________

CITY: __________ STATE: ______ ZIP: ______

PHONE BUSINESS __________ HOME __________

II. WELL LOCATION

ADDRESS: ____________________

WELL IS APPROX. ____ MILES N S E W OF __________ RD. OR ST.

WELL IDENTIFICATION # __________ LAND SIZE IN ACRES ____

III. TYPE WELL TO BE DRILLED

______ WATER PRODUCTION
______ DEWATERING
______ RECOVERY
______ SOIL BORING
______ OTHER
SPECIFY __________

______ MONITORING
______a. Groundwater quality
______b. Methane gas
______c. Water level
______d. Leachate
______e. Gas movement
______f. Chemical movement
______g. Other: __________

IV. WELL DRILLER

DRILLING COMPANY: ____________________

TENNESSEE WELL DRILLER LICENSE #: ____________________

REPRESENTATIVE: ____________________ PHONE: __________

MAILING ADDRESS: ____________________

CITY: __________ STATE: ______ ZIP: ______

V. TYPE OF WORK

______ NEW WELL
______ REWORK
______ FILL AND ABANDON

______ REPLACEMENT
______ REPAIR
______ OTHER
SPECIFY __________

VI. WELL CONSTRUCTION INFORMATION

1. EXPECTED DEPTH OF WELL: _____FT. CONSTRUCTION WATER SOURCE: _____
2. WELL CASING: TYPE MATERIAL_____ DIAMETER_____ WALL THICKNESS _____
3. TYPE OF WATER PUMPING EQUIP.: SUBMERSIBLE _____ JET_____ TURBINE_____

VII. MONITORING WELL INFORMATION

1. NUMBER OF WELLS NEEDED: _____ PROPOSED DEPTH OF WELL(S): _____
2. SUBSTANCES TO BE MONITORED FOR: _____
3. SAMPLING METHOD TO BE USED: BAILER _____ PUMP _____
4. HOW OFTEN IS WELL TO BE SAMPLED? _____

VIII. WATER WELL USAGE

_____ RESIDENTIAL _____ COMMERCIAL _____ INDUSTRIAL _____ FARM
_____ HEAT PUMP _____ SPRINKLER SYSTEM _____ IRRIGATION
_____ RETAIN LAKE LEVEL _____ OTHER (SPECIFY) _____

IX. ADDITIONAL INFORMATION REQUIRED

1. HOW MANY EXISTING WELLS ARE ON PROPERTY?
   _____ ACTIVE _____ INACTIVE OR ABANDONED _____ NONE
2. THE FOLLOWING MUST ACCOMPANY APPLICATION WHEN SUBMITTED:
   A. PLOT PLAN SHOWING ALL NEEDED INFORMATION AS STATED IN REGULATIONS.
   B. $25.00 PROCESSING FEE (DOES NOT APPLY TO FILLING AN ABANDONED WELL)
   C. ALL WELL APPLICATIONS REQUIRE AN ADDITIONAL $100.00 INSPECTION FEE (WITH THE EXCEPTION OF WATER PRODUCTION WELL APPLICATIONS).
   D. A SKETCH OF ANY PROPOSED MONITORING WELL MUST BE ENCLOSED.

THE APPLICANT AND WELL DRILLER HEREBY AGREE TO COMPLY WITH ALL RULES AND REGULATIONS ADOPTED BY THE M.S.C.H.D. TO REGULATE WATER QUALITY CONTROL WITHIN SHELBY COUNTY. FURTHERMORE, THE DUTIES WHICH ARE LISTED IN THE REGULATIONS HAVE BEEN READ BY THE APPLICANT AND BY THE WELL DRILLER, AND ARE FULLY UNDERSTOOD AND AGREED UPON.

SIGNATURE OF WELL OWNER _____ DATE_____

SIGNATURE OF WELL DRILLER _____ DATE_____

REMARKS: THE HEALTH DEPARTMENT RESERVES THE RIGHT TO SUPPLEMENT THE GENERAL REQUIREMENTS BY AN ADDENDUM AS MAY BE REQUIRED.
IF THE APPLICATION IS APPROVED BY THE HEALTH DEPARTMENT, A CONSTRUCTION PERMIT WILL BE ISSUED IN WRITING TO THE WELL DRILLER WITH A COPY BEING SENT TO THE APPLICANT. NO CONSTRUCTION IS TO BEGIN UNTIL SAID PERMIT HAS BEEN RECEIVED, AND SHALL BE KEPT AT THE CONSTRUCTION SITE UNTIL THE WELL HAS BEEN COMPLETED.

FOR DEPARTMENT USE ONLY

DATE APPLICATION RECEIVED_____ LOG NUMBER _____

PERMIT REJECTED_____ GRANTED _____ CONDITIONS _____

APPROVAL/DENIAL DATE _____ PERMIT NUMBER _____

DEPARTMENT SIGNATURE _____

CONSTRUCTION AND OPERATING AIR CONTROL APPLICATION

FORM APC-1

DATE OF SUBMITTAL________

PERMIT APPLICATION GENERAL INFORMATION

ON EACH FORM: PLEASE TYPE OR PRINT IN INK ONLY

MAIL TO:

Memphis/Shelby County Health Department
Pollution Control Section
Air Engineering Branch
814 Jefferson Avenue, #438E
Memphis, TN 38105
Attention: John Yeganeh, Supervisor

DO NOT WRITE IN THIS SPACE

AGENCY CODE	
COUNTY CODE	
SOURCE NO.	
UTM ZONE	
EW COORDINATE	
NS COORDINATE	
AIR QUALITY REGION	
REVIEWER	
DATE	

1. COMPANY NAME________

MAILING ADDRESS________

CITY/STATE ZIP CODE

2. ADDRESS AT WHICH SOURCE IS TO BE OPERATED:

ADDRESS CITY/STATE

3. TYPE OF ORGANIZATION: CORPORATION [ ] INDIVIDUAL OWNER [ ] GOVERNMENTAL AGENCY [ ]

4. BRIEF DESCRIPTION OF OPERATION OR GENERAL NATURE OF BUSINESS (PRINCIPAL PRODUCT/S):

5. PROPERTY AREA IN ACRES ________ 6. NUMBER OF EMPLOYEES AT THIS LOCATION ________

7. ANTICIPATED GROWTH IN PRODUCTION:________

8. PERMIT APPLICATION STATUS:

[ ] NEW CONSTRUCTION
[ ] MODIFICATION
[ ] PERMIT TO OPERATE REQUESTED
[✓] PERMIT RENEWAL REQUESTED
[ ] CHANGE OF LOCATION, NAME AND/OR OWNERSHIP

9. ESTIMATED COST OF EQUIPMENT OR MODIFICATION $________

AIR POLLUTION CONTROL EQUIPMENT $________

BASIC EQUIPMENT $________

10. FOR THE NEW CONSTRUCTION, MODIFICATION, TRANSFER OF LOCATION OR OWNERSHIP. WHAT IS THE ESTIMATED STARTING DATE?________ ESTIMATED COMPLETION DATE?________

11. NAME AND TITLE OF INDIVIDUAL TO CONTACT AT THE FIRM________

12. SIGNATURE OF RESPONSIBLE MEMBER OF FIRM:________ 13. OFFICIAL TITLE:________

14. TYPE OR PRINT NAME AND OFFICIAL TITLE OF PERSON SIGNING THIS APPLICATION

NAME TITLE

15. DATE OF APPLICATION________ PHONE NUMBER________

TABLE OF POLLUTION REDUCTION DEVICE OR METHOD CODES

(ALPHABETICAL LISTING)

NOTE: FOR CYCLONES, SETTLING CHAMBERS, WET SCRUBBERS, AND ELECTROSTATIC PRECIPITATORS, THE EFFICIENCY RANGES CORRESPOND TO THE FOLLOWING PERCENTAGES:

HIGH: 95 – 99+%, MEDIUM: 80 – 95%, AND LOW: LESS THAN 80%.

IF THE SYSTEM HAS SEVERAL PIECES OF CONNECTED CONTROL EQUIPMENT, INDICATE THE SEQUENCE. FOR EXAMPLE: 008/010; 97%.

IF NONE OF THE BELOW CODES FIT, USE 999 AS A CODE FOR OTHER AND SPECIFY IN THE COMMENTS.

NO EQUIPMENT	000
ACTIVATED CARBON ADSORPTION	048
AFTERBURNER – DIRECT FLAME	021
AFTERBURNER – DIRECT FLAME WITH HEAT EXCHANGER	022
AFTERBURNER – CATALYTIC	019
AFTERBURNER – CATALYTIC WITH HEAT EXCHANGER	020
ALKALIZED ALUMINA	040
CATALYTIC OXIDATION – FLUE GAS DESULFURIZATION	039
CYCLONE – HIGH EFFICIENCY	007
CYCLONE – MEDIUM EFFICIENCY	008
CYCLONE – LOW EFFICIENCY	009
DUST SUPPRESSION BY CHEMICAL STABILIZERS OR WETTING AGENTS	062
ELECTROSTATIC PRECIPITATOR – HIGH EFFICIENCY	010
ELECTROSTATIC PRECIPITATOR – MEDIUM EFFICIENCY	011
ELECTROSTATIC PRECIPITATOR – LOW TEMPERATURE	012
FABRIC FILTER – HIGH TEMPERATURE	016
FABRIC FILTER – MEDIUM TEMPERATURE	017
FABRIC FILTER – LOW TEMPERATURE	018
FABRIC FILTER – METAL SCREEN (COTTON GINS)	059
FLARING	023
GAS ABSORPTION COLUMN – PACKED	050
GAS ABSORPTION COLUMN – TRAY TYPE	051
GAS SCRUBBER (GENERAL: NOT CLASSIFIED)	013
LIMESTONE INJECTION – DRY	041
LIMESTONE INJECTION – WET	042
LIQUID FILTRATION SYSTEM	049
MIST ELIMINATOR – HIGH VELOCITY	014
MIST ELIMINATOR – LOW VELOCITY	015
PROCESS CHANGE	046
PROCESS ENCLOSED	054
PROCESS GAS RECOVERY	060
SETTLING CHAMBER – HIGH EFFICIENCY	004
SETTLING CHAMBER – MEDIUM EFFICIENCY	005
SETTLING CHAMBER – LOW EFFICIENCY	006
SPRAY TOWER (GASEOUS CONTROL ONLY)	052
SULFURIC ACID PLANT – CONTACT PROCESS	043
SULFURIC ACID PLANT – DOUBLE CONTACT PROCESS	044
SULFUR PLANT	045
VAPOR RECOVERY SYSTEM (INCLUDING CONDENSERS HOODING AND OTHER ENCLOSURES)	047
VENTURI SCRUBBER (GASEOUS CONTROL ONLY)	053
WET SCRUBBER – HIGH EFFICIENCY	001
WET SCRUBBER – MEDIUM EFFICIENCY	002
WET SCRUBBER – LOW EFFICIENCY	003
WET SUPPESSION BY WATER SPRAYS	061

TABLE OF EMISSION ESTIMATION METHOD CODES

NOT APPLICABLE. EMISSIONS ARE KNOWN TO BE ZERO	0
EMISSIONS BASED ON SOURCE TESTING	1
EMISSIONS BASED ON MATERIAL BALANCE USING ENGINEERING EXPERTISE AND KNOWLEDGE OF PROCESS	2
EMISSIONS CALCULATED USING EMISSION FACTORS FROM EPA PUBLICATION NO. AP-42 COMPILATION OF AIR POLLUTANT EMISSION FACTORS	3
JUDGEMENT	4
EMISSIONS CALCULATED USING A SPECIAL EMISSION FACTOR DIFFERING FROM THAT IN AP-42	5
OTHER (SPECIFY IN COMMENTS)	6

FORM APC-2

DATE OF SUBMITTAL ________

PERMIT APPLICATION PROCESS EMISSION SOURCE COVER SHEET

ON EACH FORM: PLEASE TYPE OR PRINT IN INK ONLY!

ONE COPY OF THIS FORM MUST BE FILLED OUT COMPLETELY FOR EACH PROCESS EMISSION SOURCE CLAIMED AND THE APPROPRIATE SHEET(S), APC-3, APC-4, ETC., ATTACHED FOR EACH EMISSION POINT. THIS COVER SHEET SHOULD BE ACCOMPANIED BY THE PERMIT APPLICATION, APC-1.

DO NOT WRITE IN THIS SPACE

AGENCY CODE
COUNTY CODE
SOURCE NO.
NO. EMISSION PTS.
EW COORDINATE
NS COORDINATE
EMISSION TYPE
REVIEWER
DATE

1. COMPANY NAME ________

2. PROCESS EMISSION SOURCE NUMBER ________

3. SIC CODE ________ 4. INITIAL STARTUP DATE ________

5. GIVE A BREIF DESCRIPTION OF THE PROCESS. OPERATION CENTERS, STORAGE POINTS, MATERIAL INPUTS, MATERIAL OUTPUTS, AND EMISSION POINTS SHOULD BE INCLUDED IN THE DESCRIPTION. NOTE: ATTACH A FLOW DIAGRAM FOR THE PROCESS EMISSION SOURCE CLAIMED (INCLUDE MATERIAL FLOW AND AIR FLOW).

____

6. TYPE OF PROCESS: ☐ CONTINUOUS ☐ BATCH ☐ COMBINED

7. OPERATING SCHEDULE:

	NORMAL	MAXIMUM
A. HOURS PER DAY		
B. DAYS PER WEEK		
C. WEEKS PER YEAR		

D. INDICATE % ANNUAL THROUGHPUT

DEC-FEB	MAR-MAY	JUNE-AUG	SEPT-NOV

FOR OFFICE USE ONLY

☐ PROCESS EMISSION SOURCE CLAIMED IS ACCEPTABLE.

☐ PROCESS EMISSION SOURCE CLAIMED IS NOT ACCEPTABLE.

WHY? ________

☐ RECOMMENDED MAKE UP OF PROCESS EMISSION SOURCE ATTACHED ON SEPARATE SHEET.
ALLOWABLE EMISSIONS (FROM AIR CODE) ____ LBS/HR., ACTUAL EMISSIONS ____ LBS/HR.

☐ PROCESS EMISSION SOURCE IS IN COMPLIANCE WITH APPLICABLE REGULATIONS.

☐ PROCESS EMISSION SOURCE IS NOT IN COMPLIANCE WITH APPLICABLE REGULATIONS.

FILING IS AUTHORIZED BY ________ DATE ________

HD-APC2-1-88

8. LIST MATERIAL INPUTS TO PROCESS EMISSION SOURCE:

NAME OF INPUT	NEW MATERIAL OR FROM OTHER PROCESS EMISSION SOURCE? (GIVE PROCESS #)	LBS/OPERATING HOUR		FLOW DIAGRAM REFERENCE
		NORMAL	MAXIMUM	
A.				
B.				
C.				
D.				
E.				
F.				
G.				
H.				
I.				
TOTAL LBS/OPERATING HOUR INPUT TO PROCESS EMISSION SOURCE				

9. LIST MATERIAL OUTPUTS FROM THIS PROCESS EMISSION SOURCE

NAME OF INPUT	GIVE # OF PROCESS IF THIS IS AN INPUT TO ANOTHER PROCESS EMISSION SOURCE	LBS/OPERATING HOUR		FLOW DIAGRAM REFERENCE
		NORMAL	MAXIMUM	
A.				
B.				
C.				
D.				
E.				
F.				
G.				
H.				
I.				
TOTAL LBS/OPERATING HOUR INPUT TO PROCESS EMISSION SOURCE				

10. LIST AIR POLLUTION EMISSION POINTS FOR THIS PROCESS EMISSION SOURCE. ATTACH A SEPARATE "EMISSION POINT DATA" SHEET, APC-3, APC-4, ETC., FOR EACH EMISSION POINT.

EMISSION POINT #, NAME, OR CODE	LBS/OPERATING HOUR						FLOW DIAGRAM REFERENCE
	PARTICULATE		SULFUR DIOXIDE		HYDROCARBON		
	NORMAL	MAXIMUM	NORMAL	MAXIMUM	NORMAL	MAXIMUM	
A.							
B.							
C.							
D.							
E.							
F.							
G.							
H.							
I.							
TOTAL LBS POLLUTANT EMITTED/OPER. HOUR							

* NOTE: ATTACH ADDITIONAL SHEETS AS REQUIRED FOR ITEMS 8, 9, AND 10.

FORM APC-3

DATE OF SUBMITTAL______

PERMIT APPLICATION STACK PROCESS EMISSION POINT DATA

ON EACH FORM: PLEASE TYPE OR PRINT IN INK ONLY!

THIS DATA SHEET SHOULD BE ACCOMPANIED BY THE PERMIT APPLICATION, APC-1, AND THE COVER SHEET, APC-2.

DO NOT WRITE IN THIS SPACE

AGENCY CODE
COUNTY CODE
SOURCE NO.
POINT NUMBER
EW COORDINATE
NS COORDINATE
EMISSION TYPE
REVIEWER
DATE

1. COMPANY NAME ______________________

2. PROCESS EMISSION SOURCE NUMBER ______________

3. EMISSION POINT NUMBER OR CODE ______________
(AS SHOWN ON PROCESS EMISSION SOURCE COVER SHEET)

4. STACK OR RELEASE POINT HEIGHT ABOVE GROUND ______________ FT.

5. DIAMETER OF STACK OR RELEASE MECHANISM AT TOP ______________ FT.

6. NORMAL GAS TEMPERATURE ______________ °F.

7. PERCENT OF TIME OVER 125 DEGREES °F ______________ %

8. EXIT GAS VELOCITY ______________ FT./SEC.

9. GAS VOLUME FLOW RATE ______________ CU. FT./SEC. @ 70 °F AND ONE ATMOSPHERE.

10. MOISTURE CONTENT ______________ GRAINS/CU. FT. DRY GAS @ 70 °F.

11. DISTANCE FROM RELEASE POINT NEAREST PROPERTY LINE ______________ FT.

12. AIR POLLUTION CONTROL EQUIPMENT

AIR CONTAMINANT CONTROLLED	YEAR INSTALLED	TYPE *	EFFICIENCY
PARTICULATE			
SULFUR DIOXIDE			
HYDROCARBONS			
OTHER			

* USE THE CODE NUMBERS SHOWN ON THE BACK OF APC-1 FOR INDICATING TYPE OF CONTROL EQUIPMENT. IF THIS EMISSION POINT HAS SEVERAL PIECES OF CONTROL EQUIPMENT, INDICATE THE SEQUENCE, AS FOR EXAMPLE: 008/010: 80%/98%

13. IS AN EMISSION MONITORING AND RECORDING INSTRUMENT ATTACHED TO THIS EMISSION POINT? YES ☐ NO ☐

IF YES, DESCRIBE ____

____

____

____

14. ADDITIONAL COMMENTS: ______________________________

15. AIR CONTAMINANT DATA FOR THIS EMISSION POINT:

POLLUTANT	ABSENT	PRESENT	CONCENTRATION QUANTITY	CONCENTRATION UNITS	NORMAL EMISSIONS (LBS/HOUR)	MAXIMUM EMISSIONS (LBS/HOUR)	METHOD OF MEASUREMENT (1)
PARTICULATES				grains/scf			
SULFUR DIOXIDE				ppm			
NITROGEN DIOXIDE(S)				ppm			
HYDROCARBONS				ppm			
CARBON MONOXIDE				ppm			
OTHERS				ppm			

(1) ATTACH A COPY OF THE TEST PROCEDURE, PROCESS MATERIAL BALANCE STUDY OR OTHER BASIS USED AS METHOD OF MEASUREMENT

FOR OFFICE USE ONLY

- [ ] PROCESS WEIGHT TABLE APPLIED TO THIS EMISSION POINT.
- [ ] EMISSION POINT IS NOT IN COMPLIANCE WITH APPLICABLE REGULATION: ______________________
- [ ] EMISSION POINT IS NOT IN COMPLIANCE WITH PARTICULATE EMISSION STANDARD.
- [ ] EMISSION POINT IS NOT IN COMPLIANCE WITH HYDROCARBON STANDARD.
- [ ] CONTINUOUS MONITOR(S) RECOMMENDED FOR ______________________

NPDES APPLICATION FOR PERMIT TO DISCHARGE PROCESS WASTEWATER

United States Environmental Protection Agency
Permits Division
Office of Water Enforcement and Permits Washington, DC 20460
EPA Form 3510-2D September 1986

EPA

Application Form 2D —

New Sources and New Dischargers:

Application for Permit to Discharge Process Wastewater

PH-3255
WPC

Please type or print in the unshaded areas only	EPA ID Number *(copy from Item 1 of Form 1)*	*Form Approved OMB No. 2040-0086 Approval expires 7-31-88*

Form **2D** NPDES

EPA New Sources and New Dischargers Application for Permit to Discharge Process Wastewater

I. Outfall Location

For each outfall, list the latitude and longitude, and the name of the receiving water.

Outfall Number *(list)*	Latitude			Longitude			Receiving Water *(name)*
	Deg	Min	Sec	Deg	Min	Sec	

II. Discharge Date *(When do you expect to begin discharging?)*

III. Flows, Sources of Pollution, and Treatment Technologies

A. For each outfall, provide a description of (1) All operations contributing wastewater to the effluent, including process wastewater, sanitary wastewater, cooling water, and stormwater runoff; (2) The average flow contributed by each operation; and (3) The treatment received by the wastewater. Continue on additional sheets if necessary.

Outfall Number	1. Operations Contributing Flow *(list)*	2. Average Flow *(include units)*	3. Treatment *(Description or List Codes from Table 2D-1)*

B. Attach a line drawing showing the water flow through the facility. Indicate sources of intake water, operations contributing wastewater to the effluent, and treatment units labeled to correspond to the more detailed descriptions in Item III-A. Construct a water balance on the line drawing by showing average flows between intakes, operations, treatment units, and outfalls. If a water balance cannot be determined (e.g., for certain mining activities), provide a pictorial description of the nature and amount of any sources of water and any collection or treatment measures.

C. Except for storm runoff, leaks, or spills, will any of the discharges described in item III-A be intermittent or seasonal?

☐ Yes *(complete the following table)* ☐ No *(go to item IV)*

Outfall Number	1. Frequency		2. Flow		
	a. Days Per Week *(specify average)*	b. Months Per Year *(specify average)*	a. Maximum Daily Flow Rate *(in mgd)*	b. Maximum Total Volume *(specify with units)*	c. Duration *(in days)*

IV. Production

If there is an applicable production-based effluent guideline or NSPS, for each outfall list the estimated level of production (projection of actual production level, not design), expressed in the terms and units used in the applicable effluent guideline or NSPS, for each of the first 3 years of operation. If production is likely to vary, you may also submit alternative estimates (attach a separate sheet).

Year	a. Quantity Per Day	b. Units of Measure	c. Operation, Product, Material, etc *(specify)*

CONTINUE ON NEXT PAGE

CONTINUED FROM THE FRONT	EPA ID Number *(copy from Item 1 of Form 1)*	Outfall Number

V. Effluent Characteristics

A, and B; These items require you to report estimated amounts *(both concentration and mass)* of the pollutants to be discharged from each of your outfalls. Each part of this item addresses a different set of pollutants and should be completed in accordance with the specific instructions for that part. Data for each outfall should be on a separate page. Attach additional sheets of paper if necessary.

General Instructions *(See table 2D-2 for Pollutants)*

Each part of this item requests you to provide an estimated daily maximum and average for certain pollutants and the source of information. Data for all pollutants in Group A, for all outfalls, must be submitted unless waived by the permitting authority. For all outfalls, data for pollutants in Group B should be reported only for pollutants which you believe will be present or are limited directly by an effluent limitations guideline or NSPS or indirectly through limitations on an indicator pollutant.

1. Pollutant	2. Maximum Daily Value *(include units)*	3. Average Daily Value *(include units)*	4. Source *(see instructions)*

CONTINUED FROM THE FRONT	EPA ID Number *(copy from Item 1 of Form 1)*	

C. Use the space below to list any of the pollutants listed in Table 2D-3 of the instructions which you know or have reason to believe will be discharged from any outfall. For every pollutant you list, briefly describe the reasons you believe it will be present.

1. Pollutant	2. Reason for Discharge

VI. Engineering Report on Wastewater Treatment

A. If there is any technical evaluation concerning your wastewater treatment, including engineering reports or pilot plant studies, check the appropriate box below.

☐ Report Available ☐ No Report

B. Provide the name and location of any existing plant(s) which, to the best of your knowledge, resembles this production facility with respect to production processes, wastewater constituents, or wastewater treatments.

Name	Location

EPA ID Number *(copy from item one of Form 1)*

VII. Other Information *(Optional)*

Use the space below to expand upon any of the above questions or to bring to the attention of the reviewer any other information you feel should be considered in establishing permit limitations for the proposed facility. Attach additional sheets if necessary.

VIII. Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

A. Name and Official Title *(type or print)*	B. Phone No.
C. Signature	D. Date Signed

CITY OF MEMPHIS, DIVISION OF PUBLIC WORKS

"INDUSTRIAL WASTEWATER DISCHARGE PERMIT"

APPLICATION

CITY OF MEMPHIS
Division of Public Works

INDUSTRIAL WASTEWATER DISCHARGE PERMIT APPLICATION INSTRUCTIONS

Please follow closely the provided instructions when completing the Application Form. All entries except for the signature, shall be at least printed or preferably typed.

SECTION A - GENERAL INFORMATION

A.1 The Corporate Name shall be the name of the official corporation of which the facility is a part. This name shall be that of the "first line" corporation, and not a parent corporation.

A.2 The Corporate Headquarters Address should be the mailing address of the headquarters of the above-named corporation.

A.3 The Company Name should be that name which is used for official transactions with the facility.

A.4 The Mailing Address should be the address to which all correspondence of an official nature regarding the facility would be sent.

A.5 The Facility Name should be that of the plant or facility for which this application is being submitted. A separate application is required for each facility. Please use the plant name which is in common usage, since this name will be referenced frequently in correspondence.

A.6 The Facility Address should be the actual street address of the above-named plant.

A.7 The Standard Industrial Classification (SIC) code for your facility should be entered on the application in decreasing order of wastewater volume produced by each activity. The SIC codes may be found in the Standard Industrial Classification Manual published in 1987 as prepared by the Office of Management and Budget, Washington, D. C. A copy of this publication may be found in most public libraries.

A.8 The Contact Official is the person, such as the plant manager, who has the responsibility for, or the knowledge of the wastewater discharges of the facility. Also provide the title and phone number of this individual.

A.9 The Signing Official should be an official of the company with the authority to sign for the company and certify the accuracy of information provided on this discharge agreement. Also provide the title and mailing address of this individual.

CITY OF MEMPHIS
Division of Public Works

SECTION A - GENERAL INFORMATION (continued)

A.9 (continued)
For the purpose of this agreement the signature will be:

(1) By a responsible corporate officer which means (i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation or (ii) the manager of one or more manufacturing, production, or operation facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents had been assigned or delegated to the manager in accordance with corporate procedures.

(2) By a general partner or proprietor if the Industrial User is a partnership or sole proprietorship respectively.

(3) By a duly authorized representative of the individual designated in (1) or (2) of this section if: (i) The authorization is made in writing by the individual described in paragraph (1) or (2); (ii) The authorization specifies either an individual or a position having responsibility for the overall operation of the facility from which the Industrial Discharge originates, such as the position of plant manager, operation of a well, or well field superintendent, or a position of equivalent responsibility, or having overall responsibility for environmental matters for the company; and (iii) The written authorization is submitted to the City of Memphis.

(4) If an authorization under (3) of this section is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, or an overall responsibility for environmental matters for a company, a new authorization satisfying the requirements of paragraph (3) of this section must be submitted to the City of Memphis prior to or together with any reports to be signed by an authoried representative.

A.10 The Signing Official should sign and date the application in the space provided only after having fully reviewed the completed application.

CITY OF MEMPHIS
Division of Public Works

SECTION B - FACILITY OPERATIONAL CHARACTERISTICS

B.1 Brief Description of the manufacturing or service activity of premises.

B.2 List the maximum quantity per day of major raw materials or feedstocks used at your facility. If you have a prepared list of raw materials, this may be submitted with the application in lieu of completing this table (daily maximum quantities must still be reported). Should the space provided prove insufficient additional sheets may be attached. Use standard units in reporting quantities used on a daily basis (e.g., lbs/day, gal/day, etc.).

B.3 List the catalysts used or required for productions and the intermediates produced at your plant.

B.4 List the products produced at your plant. Refer to the instructions listed for Item B.2.

B.5 List the by-products and waste products at your plant.

B.6 List the substances that you add to your non-contact cooling water. Also list the fate of all non-contact cooling water.

B.7 Indicate the days of operation per calendar week, e.g., Monday-Friday, Monday-Saturday, etc.

B.8 Indicate the normal hours of operation and the number of employees assigned to each shift, according to weekday or weekend operation. Be certain to designate times as am. or pm.

B.9 If deviations from normal weekly operations occur (e.g., no Wednesday afternoon shift) and/or scheduled shutdown, do indicate.

B.10 Indicate if your processes are subject to any seasonal variation. If so, provide the approximate maximum and minimum wastewater flow rates in gallons per day, of wastewater discharged to the municipal sewer system and the month(s) of the year when these occur.

B.11 Briefly describe the operational variables and frequency of occurrence that may result in an unusual discharge (e.g. regular batch discharges, weekly clean-ups, etc.).

B.12 List the person (or position held) on the plant site who may be contacted for emergency situations during plant operating hours.

B.13 List the person(s) who shall be contacted at any time during an emergency situation.

CITY OF MEMPHIS
Division of Public Works

SECTION C - WATER USAGE CHARACTERISTICS

C.1 Indicate the annual quantity of water used at your facility by source as shown in million gallons. These figures should reflect all sources of water and all uses of water.

C.2 Give the MLG&W billing address if different from the facility's address.

C.3 List all the MLG&W numbers used at the plant site.

C.4 Indicate the daily average water consumption used for the purpose listed. Domestic/Food services refers to all sanitary conveniences and shall include any food services for employees. If seasonal variations change the percentage over a year's time, provide (on an attached sheet) a percentage breakdown for the listed water usage purposes for each season, defining the applicable season (e.g., by months).

****

SECTION D - WASTEWATER CHARACTERISTICS

D.1 Indicate the average daily quantity of wastewater discharged to the municipal sanitary sewer system, in gallons per day as well as the fate of all other water discharged or lost from your plant.

D.2 List and describe the spill prevention control and counter-measure plan in effect for the facility.

D.3 Provide data for the listed parameters as determined by the analysis of samples collected by you or your representative from your facility's discharge to the municipal sanitary sewer system. Data generated by the City of Memphis's sampling of your facility is not to be supplied. Provide the most current, comprehensive data. If no data is available, enter "NA" in the appropriate blank. No survey need be immediately conducted just for the purpose of completing this application. Describe the pertinent factors of the sample/survey reported on, such as the date(s), time(s), type (grab, composite, average of composite analyses, flow-proportional), sampling location(s), etc. (See Appendix C for definitions for "daily average maximum level", "instantaneous maximum level" and "minimum pH limit", as well as the conversion formula for mg/l to #/day.

D.4 Give the name of person or laboratory responsible for the discharge sampling and analysis.

CITY OF MEMPHIS
Division of Public Works

SECTION D – WASTEWATER CHARACTERISTICS (continued)

D.5 If your facility operates wastewater pretreatment processes, so indicate and complete items a, b and c. Such processes may be as simple as the separation of oils and greases in traps or far more complex.

a. The unit processes used for wastewater pretreatment should be described here along with the wastewater quality parameter which is affected by the process. Also indicate the degree of treatment which occurs under normal operating conditions, or the efficiency of the process.

b. Any production characteristics and their associated problems which may affect the pretreatment processes should be briefly described here. Examples are changes in water flow due to normal operating schedule changes, and changes in wastewater constituents due to changes in chemical production.

c. Describe the methods used to assure the optimum operation of pretreatment processes. An example is automatic pH control by acid or caustic dosing.

D.6 List and describe batch discharges by type, volume, strength and time of discharge if being discharged.

D.7 List and describe the type and description of metering and sampling facilities for the sewer discharge in the facility.

****

SECTION E – SEWER FLOW PLAN, SITE PLAN AND PROCESS SCHEMATIC

E.1 Give the area of the plant site in acres.

E.2 Provide a flow plan or a list of sewer outlets, size, flow of your facility.

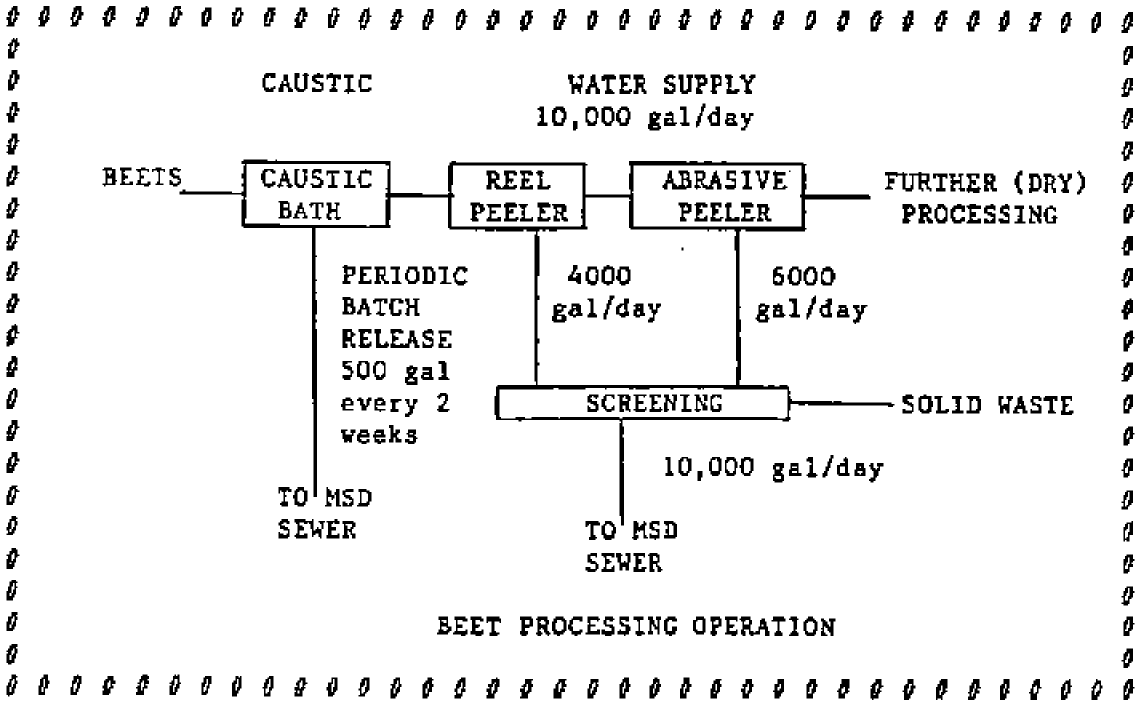
E.3 Provide a site plan of your facility indicating major structures and existing or proposed wastewater monitoring locations, drains, catch basins and other sewer access points. Also, indicate areas used for storage and processing of materials considered to be hazardous. If suitable, the space provided may be used for the plan, or a recently prepared site plan may be attached.

CITY OF MEMPHIS
Division of Public Works

SECTION E - SEWER FLOW PLAN, SITE PLAN AND PROCESS SCHEMATIC (continued)

E.4 Provide a diagram of the flow of materials and water/wastewater for your entire operations, showing all major activities and unit processes generating wastewater. Indicate daily water flow rates for normal operation conditions. If suitable, the space provided may be used for the diagram, or a recently prepared diagram may be attached.

EXAMPLE:



E.5 Provide a diagram and description of all areas with quantified acreage in square foot where storm water (run-off) are discharged into the sanitary sewer from the Industrial User facility.

****

SECTION F - SELF-MONITORING SCHEDULE

Self monitoring and analysis are required to demonstrate continuous compliance by categorical industries and/or other non-categorical

CITY OF MEMPHIS
Division of Public Works

SECTION F - SELF-MONITORING SCHEDULE (continued)

industries with high pollutant limits as determined by the City of Memphis. The results of sampling and analysis of the Discharge shall include the flow and the nature and concentration, or the production and mass where required by the controlling authority of pollutants contained therein which are limited by the applicable Pretreatment Standards. The terms and conditions will be set forth by the City of Memphis during the completion of this Discharge Agreement.

****

SECTION G - COMPLIANCE SCHEDULE

A compliance schedule is required by Industrial User for meeting categorical pretreatment standards and/or the City of Memphis pretreatment requirements. The schedule shall contain increments of the progress in the form of dates for the commencement and completion of major events leading to the construction and operation of additional pretreatment required for the Industrial User to meet the applicable local and/or categorical Pretreatment Standards. No increment shall exceed 9 months. No later than 14 days following each date in the schedule and the final date for compliance, the Industrial User shall submit a progress report to include at a minimum, whether or not it complied with the increment of progress to be met on such date and, if not, the date on which it expects to comply with this increment of progress, the reason for delay, and the steps being taken by the Industrial User to return the construction to the schedule established. In no event shall be more than 9 months elapse between such progress reports to the City of Memphis.

****

SECTION H - HAZARDOUS MATERIALS

List all hazardous, toxic, noxious or malodorous materials used or produced at your facility. Where applicable, provide both the generic and trade name of the material. Indicate the average daily usage rate (or production rate, where produced on site) of the material, as well as the typical quantity stored on site. Be certain to provide units of measurement for both of these items. As concisely as possible, provide the location(s) of both material usage and storage. If a pre-prepared listing is submitted, all required information shall still be reported.

CITY OF MEMPHIS
Division of Public Works

INDUSTRIAL WASTEWATER DISCHARGE PERMIT APPLICATION

SECTION A - GENERAL INFORMATION

A.1 Corporate Name ______________________________

A.2 Corporate Headquarters Address ______________________________
Street/P.O. Box

______________ ______________ ______________
City State Zip Code

A.3 Company Name ______________________________

A.4 Mailing Address ______________________________
Street/P.O. Box

______________ ______________ ______________
City State Zip Code

A.5 Facility Name ______________________________

A.6 Facility Address ______________________________ ______________
Street Zip Code

A.7 Standard Industrial Classification(s) a.__________ b.__________

c.__________ d.__________ e.__________ f.__________

A.8 Contact Official ______________________________
Name

______________________________ ______________
Title Telephone

A.9 Signing Official ______________________________
Name

______________ ______________________________
Title Street/P.O. Box

______________ ______________ ______________
City State Zip Code

A.10 I certify that the information contained in this application consisting of seventeen pages (and any appendices) is familiar to me and to the best of my knowledge and belief, such information is true, complete and correct.

______________________________ ______________
Signature Date

CITY OF MEMPHIS
Division of Public Works

SECTION B - FACILITY OPERATIONAL CHARACTERISTICS

B.1 Brief Description of manufacturing or service activity of premises ______

____

____

B.2 Raw Materials

Type	Quantity Used

[ ] Pre-prepared list attached.

[ ] Above listing continued on attached sheet(s)

B.3 Catalysts, Intermediates

Type	Quantity Used

[ ] Pre-prepared list attached.

[ ] Above listing continued on attached sheet(s)

CITY OF MEMPHIS
Division of Public Works

SECTION B - FACILITY OPERATIONAL CHARACTERISTICS (continued)

B.4 Principal Products

Type	Quantity Produced

[ ] Pre-prepared list attached.

[ ] Above listing continued on attached sheet(s)

B.5 By-products and Waste Products

Type	Quantity Produced

[ ] Pre-prepared list attached.

[ ] Above listing continued on attached sheet(s)

CITY OF MEMPHIS
Division of Public Works

SECTION B - FACILITY OPERATIONAL CHARACTERISTICS (continued)

B.6 Components of Non-contact Cooling Water

Type	Quantity Added
____________	____________
____________	____________
____________	____________
____________	____________

[ ] Pre-prepared list attached.

[ ] Above listing continued on attached sheet(s)

B.7 Weekly days of operation are ____________.

B.8 Indicate the hours of operation of your facility and the number of employees per shift.

Shift	Start/Stop Times	Number of Employees: Weekday	Saturday	Sunday
Day	_____ - _____	_____	_____	_____
Evening	_____ - _____	_____	_____	_____
Night	_____ - _____	_____	_____	_____

B.9 Other operations scheduled characteristics/scheduled shutdown: ____________

____

____________.

B.10 Is your facility's production operation subject to seasonal variation? ________ If so, please complete the following:

Seasonal maximum wastewater discharged to the municipal sewer system ________ gal/day, during the months of ____________.

Seasonal minimum wastewater discharged to the municipal sewer system ________ gal/day, during the months of ____________.

CITY OF MEMPHIS
Division of Public Works

B.11 Briefly describe the operational variables and frequency of occurrence that may result in an unusual discharge from your facility.

____

____

____

____

[ ] Additional sheets attached.

B.12 List the person (or position held) on the plant site who may be contacted for emergency situations during plant operating hours.

Name ____________________ Position ____________________

Phone Number ____________________

B.13 List the person(s) who shall be contacted at any time during an emergency situation.

Name ____________________ Phone Number ____________________

____________________ ____________________

____________________ ____________________

____________________ ____________________

CITY OF MEMPHIS
Division of Public Works

SECTION C - WATER USAGE CHARACTERISTICS

C.1 Estimated annual water usage by source:

Source	Million Gallons
Public water supply	______
Private well	______
Surface stream	______

C.2 MLG&W Billing Address (if different from A.6)

Street/P.O. Box	City	State	Zip Code

C.3 MLG&W Account Number (or numbers) ______

______

______

______

C.4 List of Daily Average water consumption in the plant:

Purpose	Gallons per Day
Process (industrial)	______
Non-contact cooling	______
Boiler Feed	______
Incorporated in product	______
Domestic/Sanitary	______
Other	______

[ ] Breakdown of seasonal percentages on attached sheet.

CITY OF MEMPHIS
Division of Public Works

SECTION D - WASTEWATER CHARACTERISTICS

D.1 List of Daily Average of volume of discharge or water loss to:

Method of Discharge or Loss	Gallons per Day
City Wastewater sewer	______
Storm sewer	______
Waste Hauler	______
Evaporative loss	______
Incorporated in product	______

[ ] Breakdown of seasonal percentages on attached sheet.

D.2 List and describe the spill prevention control and counter-measure plan that is in effect for the facility. ______________________

____

____

____

____

[ ] Additional sheets attached.

CITY OF MEMPHIS
Division of Public Works

SECTION D - WASTEWATER CHARACTERISTICS (continued)

D.3 The analysis of wastewater discharged to the municipal sanitary sewer system is given below: (* See Appendix C)

PARAMETER	*DAILY AVERAGE MAXIMUM LEVEL mg/l	#/day	*INSTANTANEOUS MAXIMUM LEVEL mg/l	#/day
Biochemical Oxygen Demand (BOD_5)				
Total Suspended Solids				
Total Solids				
Oil and Grease (Hydrocarbons)				
Oil and Grease (Total)				
Ammonia Nitrogen (NH_3-N)				
Total Kjeldahl Nitrogen (TKN)				

Alkalinity ________
(Pounds of 100% sulfuric acid per day.(See Appendix B)

Acidity ________
(Pounds of 100% sodium hydroxide per day.(See Appendix B)

	Range Minimum	Maximum
Temperature (Degree Fahrenheit)		
pH (Standard Units) (See Appendix C)		

[ ] Analysis sheet attached.

Sample/Survey description: ________

OTHER POLLUTANTS: These are Priority Pollutants and other substances that may be present in the wastewater discharge. See Appendix A and C.

CITY OF MEMPHIS
Division of Public Works

SECTION D - WASTEWATER CHARACTERISTICS (continued)

D.4 Give the name of person or laboratory responsible for the discharge sampling and analysis ______________________________

____.

D.5 Is your facility's wastewater treated prior to discharge to the municipal sewer system? ________ If yes, complete the following:

a. Briefly describe the unit processes used and the wastewater quality before and after treatment.

____

____

____

____

____

____

______________________ . [ ] Additional sheets attached.

b. Briefly describe your facility's production characteristic and any persistent or normal operational problems that may affect the operation of the pretreatment system.

____

____

____

____

____

____

______________________ . [ ] Additional sheets attached.

CITY OF MEMPHIS
Division of Public Works

SECTION D - WASTEWATER CHARACTERISTICS (continued)

c. Briefly describe the quality testing or process control methodology maintained to ensure acceptable pretreatment levels.

____
____
____
____
____
____
____
____

[ ] Additional sheets attached.
[ ] Copy of typical operating data maintained attached.

D.6 Any batch discharges? _________. If yes, describe type, volume, strength and time of discharge.

____
____
____

D.7 List type and description of metering and sampling facilities for sewage discharge, if any.

____
____
____

CITY OF MEMPHIS
Division of Public Works

SECTION E - SEWER FLOW PLAN, SITE PLAN AND PROCESS SCHEMATICS

E.1 Give the area of plant site in acres: ____________.

E.2 Sewer plan - Provide a flow plan or a list of sewer outlets, size, flow of your facility.

[ ] Sewer plan or map of facility attached.

CITY OF MEMPHIS
Division of Public Works

SECTION E - SEWER PLAN, SITE PLAN AND PROCESS SCHEMATICS (continued)

E.3 Site Plan - Provide a plan of your facility indicating major structures and the locations of hazardous materials and certain sewer appurtenances.

[ ] Site plan attached.

SECTION E - SITE PLAN AND PROCESS SCHEMATICS (continued)

E.4 Schematic Flow Diagram - Provide a diagram of the flow of materials process for your facility.

[ ] Schematic flow of material or process diagram attached.

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CITY OF MEMPHIS
Division of Public Works

SECTION E - SITE PLAN, SITE PLAN AND PROCESS SCHEMATICS (continued)

E.5 Permitted Storm Area - Provide a diagram and description of areas with quantified acreage in square feet where storm water (run-off) is discharged into the sanitary sewer at your facility.

Total acreage: __________ sq. ft.

[ ] Storm area diagram attached.

CITY OF MEMPHIS
Division of Public Works

SECTION F - SELF-MONITORING SCHEDULE

The self monitoring requirement will be determined by the Pretreatment Program requirement and the City of Memphis and to be performed and/or reported by the Industrial User.

CITY OF MEMPHIS
Division of Public Works

SECTION G - COMPLIANCE SCHEDULE

Provide the compliance schedule as required to meet categorical pretrea standards and other requirements required by the City of Me pretreatment program.

[ ] pre-prepared compliance schedule attached.

COPY OF BEST PAGE AVAILABLE

CITY OF MEMPHIS
Division of Public Works

SECTION H - HAZARDOUS MATERIALS

List all hazardous, toxic, noxious or malodorous materials used, produced or formed as by-product or waste at your facility.

Generic Name	Trade Name	Daily Usage or Production	Inventory	Location(s) Usage/Production	Location(s) of Storage

[ ] Pre-prepared Listing attached.
[ ] Above Listing continued on attached sheets(s)

CITY OF MEMPHIS
Division of Public Works
TABLE I

MAXIMUM EFFLUENT STANDARDS FOR DISCHARGE OF WASTE INTO THE MUNICIPAL SEWERAGE SYSTEM.

Constituent	Daily Average* Maximum Concentration mg/l	Instantaneous Maximum Concentration mg/l
Biochemical oxygen demand	(1)	(1)
Settleable solids (ml/l)	(1)	(1)
Total suspended solids	(1)	(1)
Nitrogen (total Kjeldahl)	(1)	(1)
Arsenic	1.0	2.0
Cadmium	(2)	(2)
Chromium (hexavalent)	1.0	2.0
Chromium (total)	5.0	10.0
Copper	5.0	10.0
Cyanide (oxidizable)	2.0	4.0
Cyanide (total)	4.0	8.0
Lead	(2)	(2)
Mercury	(2)	(2)
Nickel	5.0	10.0
Zinc	5.0	10.0
Ammonia NH_3N	125 ppm	250 ppm

* Based on 24-hour flow-proportionate composite sample (1) Consistent with treatment plant capacity (2) Cadmium, mercury, and lead discharges are severely restricted due to limitations placed on the disposal of sewage sludge containing cadmium, mercury, and/or lead. Actual allowable discharge concentrations for these constituents will be determined on a case by case basis.

No person shall discharge wastewater containing any of the materials listed herein into the municipal sewer system or shall have any connection to the municipal sewer system without obtaining written permission from the Approving Authority.

Acrylonitrile
Alpha BHC
Aldrin
Aluminum
Barium
Benzene
Benzo (a) pyrene
Benzotrichloride
Beryllium
Bis(2-ethylhexl)phathalate (DEHP)
3,3-Dichlorobenzidene
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethlyene
Dichloroethyl ether(Bis(2-chloroethyl))
1,2-Cis,dichloroethylene
1,2-Trans,dichloroethylene
1,2-Dichloropropane
1,3-Dichloropropane

CITY OF MEMPHIS
Division of Public Works
TABLE I

Bromobenzene
Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorodane
Chlorobenzene
Chlorodibromomethane
Chloroethane
Chloroform
2-Chlorophenol
O-Chlorotoluene
P-Chlorotoluene
Cumene
DDT/DDE/DDD
1,2-Dibromo-3-Chloropane
Dibutylphathalate
1,4-Dichlorobenzene(p)
Hexachlorobutadiene

Isopropylbenzene
Lindane
Methyl chloride
(Chloromethane)
Molybdenum
PCB-1260

Phenols
Pyrene
Octachlorodibenzo-P-Dioxin
Octachlorodibenzofuran
Total Heptachlorodibenzo-P-Dioxins
Total Heptachlorodibenzofurans
Total Hexachlorodibenzo-P-Dioxins
Total Hexachlorodibenzofurans
Total Pentachlorodibenzo-P-Dioxins
Total Pentachlorodibenzofurans
Total Tetrachlorodibenzo-P-Dioxins
Total Tetrachlorodibenzofurans
1,2,3,4,6,7,8-Heptchlorodibenzo-P-Dioxins
1,2,3,4,6,7,8-Heptachlorodibenzofuran
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin
1,2,3,4,7,8-Hexachlorodibenzofuran
1,2,3,4,7,8,9-Heptachlorodibenzofuran
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin
1,2,3,6,7,8-Hexachlorodibenzofuran
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin
1,2,3,7,8-Pentachlorodibenzofuran

2,2-Dichloropropane
1,1-Dichloropropane
1,3-Dichloropropene
M-Dichlorobenzene
O-Dichlorobenzene
Para-Dichlorobenzene
Dieldrin
Diisobutylenes
Dimethlnitrosamine
2,4-Dinitrophenol
2,4-Dinitroluene
Ethyl benzene
Heptachlor
Hexachlorobenzene

Tin
Titanium
Toluene
Toxaphene (chlorinated camphene)
1,1,2-Trichloroethane

Trichloroethylene
1,2,3-Trichloropropane
Vinyl chloride
O,M,P-Xylenes
1,1,1,2-Tetrachloroethane

CITY OF MEMPHIS
Division of Public Works
TABLE I

1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin
1,2,3,7,8,9-Hexachlorodibenzofuran
2,3,4,6,7,8-Hexachlorodibenzofuran
2,3,4,7,8-Pentachlorodibenzofuran
2,3,7,8-Tetrachlorodibenzo-P-Dioxin
2,3,7,8-Tetrachlorodibenzofuran

Approving Authority reserves the right to modify this list of materials prohibited from entering the POTW as may become necessary.

CITY OF MEMPHIS
Division of Public Works

TABLE 2

GUIDANCE CONCENTRATIONS IN MUNICIPAL SEWAGE TREATMENT INFLUENT

Parameter	South Plant Average Influent Concentrations	North Plant Average Influent Concentrations
BOD (Biochemical oxygen demand)	(1)	(1)
SS (Settleable solids)	(1)	(1)
TSS (Total suspended solids)	(1)	(1)
Nitrogen (Total Kjeldahl)	(1)	(1)
pH	6-9	6-9
Temperature	(2)	(2)
Arsenic	-	-
Cadmium	0.005 ppm	0.005 ppm
Chromium (Hexavalent)	-	-
Chromium (Total)	0.375 ppm	0.375 ppm
Cyanide (Oxidizable)	-	-
Cyanide (Total)	0.605 ppm	0.605 ppm
Lead	0.25 ppm	0.25 ppm
Mercury	0.0042 ppm	0.0042 ppm
Nickel	0.273 ppm	0.273 ppm
Zinc	1.0 ppm	1.0 ppm
Copper	0.5 ppm	0.5 ppm
Silver	0.0294 ppm	0.0294 ppm
Phenols	4.5 ppm	4.5 ppm
Oil & Grease	100 ppm	100 ppm
Toluene	0.429 ppm	2.0 ppm
Phenol	1.273 ppm	0.909 ppm
Methylene Chloride	0.25 ppm	0.25 ppm
Benzene	0.043 ppm	0.043 ppm
1,1,1 Trichloroethane	0.5 ppm	0.25 ppm
Ethyl Benzene	0.04 ppm	0.04 ppm
Carbon Tetrachloride	0.075 ppm	0.075 ppm
Chloroform	0.224 ppm	0.368 ppm
Tetrachloroethylene	0.139 ppm	0.139 ppm
Trichloethylene	0.150 ppm	0.150 ppm
1,2 Transdichloroethylene	0.030 ppm	0.030 ppm
Napthalene	0.312 ppm	0.312 ppm
Bis(2 Ethyl Hexyl Phthalate)	0.105 ppm	0.105 ppm
Butyl Benzl Phthalate	0.333 ppm	0.333 ppm
Di-n-butyl Phthalate	0.0625 ppm	0.0625 ppm
Diethyl Phthalate	0.222 ppm	0.222 ppm

CITY OF MEMPHIS-
Division of Public Works

TABLE 2 (continued)

MASS LIMITATIONS - No individual shall discharge a mass loading of the compounds detailed in Table 2 more than 15% of the average allowable influent loading on an average maximum level. When comparing these mass limitations and the concentration based on limitation in Table 1, whichever limitation that is more restrictive will apply, unless a variance is obtained as described in paragraph (c) of this section.

(1) Consistent with treatment plant capacity as determined by the Division of Public Works. (2) Temperature always to be less than 104 degree Fahrenheit (40 degrees Centigrade).

CITY OF MEMPHIS
Division of Public Works

APPENDIX A

*** METALS AND NONMETALLIC ELEMENTS ***

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
	ALUMINUM				
114	ANTIMONY				
115	ARSENIC				
	BARIUM				
117	BERYLLIUM				
	BISMUTH				
	BORON				
118	CADMIUM				
	CALCIUM				
	CERIUM				
119	CHROMIUM (TOTAL)				
	CHROMIUM (HEXVALENT)				
	COBALT				
120	COPPER				
	DYSPROSIUM				
	ERBIUM				
	EUROPIUM				
	GADOLINIUM				
	GALLIUM				
	GERMANIUIM				
	GOLD				
	HAFNIUM				
	HOLMIUM				
	INDIUM				
	IODINE				
	IRIDIUM				
	IRON				
	LANTHANUM				
122	LEAD				
	LITHIUM				
	LUTETIUM				
	MAGNESIUM				
	MANGANESE				
123	MERCURY				
	MOLYBDENUM				
	NEODYMIUM				
124	NICKEL				
	NIOBIUM				
	OSMIUM				
	PALLADIUM				
	PHOSPHORUS				

CITY OF MEMPHIS
Division of Public Works

APPENDIX A

*** METALS AND NONMETALLIC ELEMENTS ***

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
	PLATINUM				
	POTASSIUM				
	PRASEODYMIUM				
	RHENIUM				
	RHODIUM				
	RUTHENIUM				
	SAMARIUM				
	SCANDIUM				
125	SELENIUM				
	SILICON				
126	SILVER				
	SODIUM				
	STRONTIUM				
	SULFUR				
	TANTALUM				
	TELLURIUM				
	TERBIUM				
127	THALLIUM				
	THORIUM				
	THULIUM				
	TIN				
	TITANIUM				
	TUNGSTEN				
	URANIUM				
	VANADIUM				
	YTTERBIUM				
	YTTRIUM				
128	ZINC				
	ZIRCONIUM				

****

*** CLASSICAL ***

121	CYANIDE (TOTAL)				
	CYANIDE (OXIDIZABLE)				
	FLUORIDE				
	NITRATE - NITROGEN				
	NITRITE - NITROGEN				
	RADIOACTIVE MATERIAL				

CITY OF MEMPHIS
Division of Public Works

APPENDIX A

*** DIOXINS/FURANS ***

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
	OCTACHLORODIBENZO-P-DIOXIN				
	OCTACHLORODIBENZOFURAN				
	TOTAL HEPTACHLORODIBENZO-P-DIOXIN				
	TOTAL HEPTACHLORODIBENZOFURANS				
	TOTAL HEXACHLORODIBENZO-P-DIOXINS				
	TOTAL HEXACHLORODIBENZOFURANS				
	TOTAL PENTACHLORODIBENZO-P-DIOXINS				
	TOTAL PENTACHLORODIBENZOFURANS				
	TOTAL TETRACHLORODIBENZO-P-DIOXINS				
	TOTAL TETRACHLORODIBENZOFURANS				
	1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN				
	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN				
	1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN				
	1,2,3,4,7,8-HEXACHLORODIBENZOFURAN				
	1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN				
	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN				
	1,2,3,6,7,8-HEXACHLORODIBENZOFURAN				
	1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN				
	1,2,3,7,8-PENTACHLORODIBENZOFURAN				
	1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN				
	1,2,3,7,8,9-HEXACHLORODIBENZOFURAN				
	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN				
	2,3,4,7,8-PENTACHLORODIBENZOFURAN				
129	2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCCD)				
	2,3,7,8-TETRACHLORODIBENZOFURAN				

CITY OF MEMPHIS
Division of Public Works

APPENDIX A

*** FIBROUS ***

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
116	ASBESTOS				

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*** VOLATILE ORGANICS ***

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
3	ACRYLONITRILE				
4	BENZENE				
	BROMODICHLOROMETHANE				
46	BROMOMETHANE (METHYL BROMIDE)				
	CARBON DISULFIDE				
50	CHLOROACETONITRILE				
7	CHLOROBENZENE				
51	CHLORODIBROMOMETHANE				
16	CHLOROETHANE				
23	CHLOROFORM (TRICHLOROMETHANE)				
45	CHLOROMETHANE (METHYL CHLORIDE)				
	CIS-1,3-DICHLOROPROPENE				
	CROTONALDEHYDE				
48	DICHLOROBROMOMETHANE				
	DIBROMOMETHANE				
	DIETHYL ETHER				
	ETHYL CYANIDE				
	ETHYL METHACRYLATE				
38	ETHYLBENZENE				
	IODOMETHANE				
	ISOBUTYL ALCOHOL				
	M-XYLENE				
	METHYL METHACRYLATE				
44	METHYLENE CHLORIDE (DICHLOROMETHANE)				
	O+P XYLENE				
85	TETRACHLOROETHENE				

CITY OF MEMPHIS
Division of Public Works

APPENDIX A

*** VOLATILE ORGANICS ***

Continued

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
6	TETRACHLOROMETHANE (CARBON TETRACHLORIDE)				
86	TOLUENE				
	TRANS-1,2-DICHLOROETHENE				
	TRANS-1,3-DICHLOROPROPENE				
	TRANS-1,4-DICHLORO-2-BUTENE				
47	TRIBROMOMETHANE (BROMOFORM)				
87	TRICHLOROETHENE (TRICHLOROETHYLENE)				
49	TRICHLOROFLUOROMETHANE				
	VINYL ACETATE				
88	VINYL CHLORIDE (CHLOROETHYLENE)				
13	1,1-DICHLOROETHANE				
	1,1-DICHLOROETHENE				
29	1,1-DICHLOROETHYLENE				
30	1,2-TRANS-DICHLOROETHYLENE				
11	1,1,1-TRICHLOROETHANE				
	1,1,1,2-TETRACHLOROETHANE				
14	1,1,2-TRICHLOROETHANE				
15	1,1,2,2-TETRACHLOROETHANE				
	1,2-DIBROMOETHANE				
10	1,2-DICHLOROETHANE				
	1,2-DICHLOROPROPANE				
	1,2,3-TRICHLOROPROPANE				
	1,3-BUTADIENE, 2-CHLORO				
32	1,3-DICHLOROPROPANE				
33	1,3-DICHLOROPROPYLENE				
	1,4-DIOXANE				
	2-BUTANONE				
19	2-CHLOROETHYVINYL ETHER (MIXED)				
	2-HEXANONE				
	2-PROPANONE				
	2-PROPEN-1-OL				
2	2-PROPENAL (ACROLEIN)				
	2-PROPENENITRILE, 2-METHYL				
	3-CHLOROPROPENE				
	4-METHYL-2-PENTANONE				

APPENDIX A

*** SEMIVOLATILE ORGANICS ***

Continued

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
1	ACENAPHTHENE				
77	ACENAPHTHYLENE				
	ACETOPHENONE				
	ALPHA-TERPINEOL				
	ANILINE				
	ANILINE, 2,4,5-TRIMETHYL				
78	ANTHRACENE				
	ARAMITE				
	BENZANTHRONE				
	BENZENETHIOL				
5	BENZIDINE				
72	BENZO(A)ANTHRACENE (1,2 BENZANTHRACENE)				
73	BENZO(A)PYRENE (3,4-BENZOPYRENE)				
74	BENZO(B)FLUORANTHENE (3,4-BENZOFLUORANTHENE)				
79	BENZO(GHI)PERYLENE (1,12-BENZOPERYLENE)				
75	BENZO(K)FLUORANTHANE (11,12-BENZOFLUORANTHENE)				
	BENZOIC ACID				
	BENZONITRILE, 3,5-DIBROMO-4-HYDROXY-				
	BENZYL ALCOHOL				
	BETA-NAPHTHYLAMINE				
	BIPHENYL				
	BIPHENYL, 4-NITRO				
17	BIS(CHLOROMETHYL) ETHER				
43	BIS(2-CHLOROETHOXY)METHANE				
18	BIS(2-CHLOROETHYL) ETHER				
42	BIS(2-CHLOROISOPROPYL) ETHER				
66	BIS(2-ETHYLHEXYL) PHTHALATE				
67	BUTYL BENZYL PHTHALATE				
	CARBAZOLE				
76	CHRYSENE				
	CROTOXYPHOS				
68	DI-N-BUTYL PHTHALATE				
69	DI-N-OCTYL PHTHALATE				
63	DI-N-PROPYLNITROSAMINE (N-NITROSODI-N-PROPYLAMINE)				
	DIBENZO(A,H)ANTHRACENE				
	DIBENZOFURAN				
	DIBENZOTHIOPHENE				
70	DIETHYL PHTHALATE				

CITY OF MEMPHIS
Division of Public Works

APPENDIX A

*** SEMIVOLATILE ORGANICS ***

Continued

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
71	DIMETHYL PHTHALATE				
	DIMETHYL SULFONE				
	DIPHENYL ETHER				
	DIPHENYLAMINE				
	DIPHENYLDISULFIDE				
	ETHANE, PENTACHLORO				
	ETHYL METHANESULFONATE				
	ETHYLENETHIOUREA				
39	FLUORANTHENE				
80	FLUORENE				
9	HEXACHLOROBENZENE				
52	HEXACHLOROBUTADIENE				
53	HEXACHLOROCYCLOPENTADIENE				
12	HEXACHLOROETHANE				
	HEXACHLOROPROPENE				
	HEXANOIC ACID				
83	INDENO(1,2,3-CD)PYRENE				
54	ISOPHORONE				
	ISOSAFROLE				
	LONGIFOLENE				
	MALACHITE GREEN				
	MESTRANOL				
	METHAPYRILENE				
	METHYL METHANESULFONATE				
	N-DECANE				
	N-DOCOSANE				
	N-DODECANE				
	N-EICOSANE				
	N-HEXACOSANE				
	N-HEXADECANE				
	N-NITROSODI-N-BUTYLAMINE				
	N-NITROSODIETHYLAMINE				
61	N-NITROSODIMETHYLAMINE				
	N-NITROSODIPHENYLAMINE				
	N-NITROSOMETHYLETHYLAMINE				
62	N-NITROSOMETHYLPHENYLAMINE				
	N-NITROSOMORPHOLINE				
	N-NITROSOPIPERDINE				
	N-OCTACOSANE				
	N-OCTADECANE				
	N-TETRACOSANE				
	N-TETRADECANE				
	N-TRIACONTANE				

CITY OF MEMPHIS
Division of Public Works

APPENDIX A

*** SEMIVOLATILE ORGANICS *** Continued

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
	N,N-DIMETHYLFORMAMIDE				
55	NAPHTHALENE				
56	NITROBENZENE				
	O-ANISIDINE				
	O-CRESOL				
	O-TOLUIDINE				
	O-TOLUIDINE, 5-CHLORO				
22	PARACHLOROMETACRESOL				
	P-CHLOROANILINE				
	P-CRESOL				
	P-CYMENE				
	P-DIMETHYLAMINOAZOBENZENE				
	P-NITROANILINE				
	PENTACHLOROBENZENE				
64	PENTACHLOROPHENOL				
	PENTAMETHYLBENZENE				
	PERYLENE				
	PHENACETIN				
81	PHENANTHRENE				
65	PHENOL				
	PHENOTHIAZINE				
	PRONAMIDE				
84	PYRENE				
	PYRIDINE				
	RESORCINOL				
	SAFROLE				
	SQUALENE				
	STYRENE				
	THIANAPHTHENE				
	THIOACETAMIDE				
	THIOXANTHE-9-ONE				
	TOLUENE, 2,4-DIAMINO				
	TRIPHENYLENE				
	TRIPROPYLENEGLYCOL METHYL ETHER				
	1-BROMO-2-CHLOROBENZENE				
	1-BROMO-3-CHLOROBENZENE				
	1-CHLORO-3-NITROBENZENE				
	1-METHYLFLUORENE				
	1-METHYLPHENANTHRENE				
	1-NAPHTHYLAMINE				
	1-PHENYLNAPHTHALENE				
	1,2-DIBROMO-3-CHLOROPROPANE				
25	1,2-DICHLOROBENZENE				

APPENDIX A

*** SEMIVOLATILE ORGANICS *** Continued

PRIORITY POLLUTANT NUMBER	ANALYTE	DAILY AVERAGE MAXIMUM LEVEL mg/l	DAILY AVERAGE MAXIMUM LEVEL #/day	INSTANTANEOUS MAXIMUM LEVEL mg/l	INSTANTANEOUS MAXIMUM LEVEL #/day
37	1,2-DIPHENYLHYDRAZINE				
	1,2,3-TRICHLOROBENZENE				
	1,2,3-TRIMETHOXYBENZENE				
8	1,2,4-TRICHLOROBENZENE				
	1,2,4,5-TETRACHLOROBENZENE				
82	1,2,5,6-DIBENZANTHRACENE				
	1,2,3,4-DIEPOXYBUTANE				
	1,3-DICHLORO-2-PROPANOL				
26	1,3-DICHLOROBENZENE				
	1,3,5-TRITHIANE				
27	1,4-DICHLOROBENZENE				
	1,4-DINITROBENZENE				
	1,4-NAPHTHOQUINONE				
	1,5-NAPHTHALENEDIAMINE				
	2-(METHYLTHIO)BENZOTHIAZOLE				
20	2-CHLORONAPHTHALENE				
24	2-CHLOROPHENOL				
	2-IOSPROPYLNAPHTHALENE				
	2-METHYLBENZOTHIOAZOLE				
	2-METHYLNAPHTHALENE				
	2-NITROANILINE				
57	2-NITROPHENOL				
	2-PHENYLNAPHTHALENE				
	2-PICOLINE				
	2,3-BENZOFLUORENE				
	2,3-DICHLOROANILINE				
	2,3-DICHLORONITROBENZENE				
	2,3,4,6-TETRACHLOROPHENOL				
	2,3,6-TRICHLOROPHENOL				
31	2,4-DICHLOROPHENOL				
34	2,4-DIMETHYLPHENOL				
59	2,4-DINITROPHENOL				
35	2,4-DINITROTOLUENE				
	2,4,5-TRICHLOROPHENOL				
	2,4,6-TRICHLOROPHENOL				
	2,6-DI-TERT-BUTYL-P-BENZOQUINONE				
	2,6-DICHLORO-4-NITROANILINE				
	2,6-DICHLOROPHENOL				
36	2,6-DINITROTOLUENE				
	3-METYLCHOLANTHRENE				
	3-NITROANILINE				
28	3,3'-DICHLOROBENZIDINE				

RULES OF "TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT BUREAU OF ENVIRONMENT DIVISION OF AIR POLLUTION CONTROL"

CHAPTER 1200-3-9 CONSTRUCTION AND OPERATING PERMITS

RULES
OF
TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT
BUREAU OF ENVIRONMENT
DIVISION OF AIR POLLUTION CONTROL

CHAPTER 1200-3-9
CONSTRUCTION AND OPERATING PERMITS

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1200-3-9-.01 CONSTRUCTION PERMITS

(1) Application for Construction Permit

(a) No person shall begin the construction of a new air contaminant source or the modification of an air contaminant source which may result in the discharge of air contaminants without first having applied for and received from the Technical Secretary a construction permit for the construction or modification of such air contaminant source.

(b) The application for a construction permit shall be made on forms available from the Technical Secretary not less than ninety (90) days prior to the estimated starting date of construction. Sources identified in paragraph 1200-3-9-.01(4) shall make application for a construction permit not less one hundred twenty (120) days prior to the estimated date of construction.

(c) When a source will have a significant impact on air quality as defined in subparagraph 1200-3-9-.01(2)(a) the Technical Secretary shall not issue a permit until there has been an opportunity for public comment concerning the allocation of remaining air resources. Comments shall be made in writing and delivered to the Technical Secretary within fifteen (15) days after the publication of the public notice. Competing interests in air quality usage may request Board consideration in allocating the remaining air resources. The applicant for a construction permit shall notify the public, by advertisement in a newspaper of general circulation in each air quality control region in which the proposed source or modification

(c) Particulate matter air contaminant sources that locate in or have a significant impact on air quality in the Kingsport additional control area as defined in Chapter 1200-3-9.

1. Any air contaminant source which emits, or has the potential to emit 5 tons per year or more of particulate matter shall utilize best available control technology as specified by the Technical Secretary at the time of the completed permit application.

2. "Significant impact on air quality" is defined as specified in subparagraph (a) of Rule 1200-3-9-.01(2).

3. "Potential to emit" is defined as specified in part 5 of Rule 1200-3-9-.01(4)(b).

(6) Construction permits issued under this rule are based on the control of air contaminants only and do not in any way affect the applicant's obligation to obtain necessary permits from other governmental agencies.

(7) The applicant for a construction permit (or its equivalent by Board order) shall pay the cost of publication of any notices required by state or federal law or regulations to effectuate the rights applied for.

Authority: T.C.A. Section 68-25-105 and 4-5-202. Administrative History. Original Rule certified June 4, 1974. Amended effective February 9, 1977. Amended April 12, 1978. Amended June 16, 1978. Amended March 21, 1979. Amended June 21, 1979. Amended November 16, 1979. Emergency rule effective June 3, 1981 through October 1, 1981. Revised effective July 31, 1981. Amended effective October 3, 1981. Amended effective January 22, 1982. Amended effective March 2, 1983. Amended effective August 22, 1983. Amended effective November 6, 1988. Amended effective June 2, 1990. Amended effective July 1, 1990.

1200-3-9-.02 OPERATING PERMITS

(1) Any person planning to operate an air contaminant source constructed or modified in accordance with a construction permit issued by the Technical Secretary in Rule 1200-3-9-.01 of this chapter shall apply for and receive an operating permit from the Technical Secretary after initial startup of the said air contaminant source. Ninety (90) days shall be allowed for this, provided paragraph (3) of this rule is complied with. This time period is extended from ninety (90) to one hundred twenty (120) days if stack sampling has been required as a condition on the construction permit, which is further extended to sixty (60) days after the stack sampling report is required on the construction if a certain time is specified, provided the stack sampling report is filed with the Division within sixty (60) days of initial startup or the time specified on the construction permit and that paragraph (3) of this rule is complied with.

(2) No person shall operate an air contaminant source in Tennessee without first obtaining an operating permit from the Technical Secretary except as specifically exempted in Rule 1200-3-9-.04. New sources operating with a valid construction permit may operate with the construction permit for the time period specified in paragraph (1) above.

(3) Application for an operating permit shall be made on forms available from the Technical Secretary and signed by the applicant. Such application for an operating permit shall be filed with the Technical Secretary:

(a) Not less than sixty (60) days prior to the expiration of an existing operating permit.

(b) 1. Not more than thirty (30) days after initial startup of an air contaminant source constructed or modified in accordance with a construction permit issued by the Technical Secretary.

2. If stack sampling data has been required as a condition on the construction permit, this time period is extended to the time specified on the construction permit for submittal of the stack sampling report(s). In no case shall this period exceed 180 days after startup.

(4) The operating permit shall only be issued on evidence satisfactory to the Technical Secretary that the operation of said air contaminant source is in compliance with any standards or rules and regulations promulgated by the Board and that the operation of said air contaminant source will not interfere with the attainment or maintenance of any air quality standard. Such evidence may include a requirement that the applicant conduct such tests as are necessary in the opinion of the Technical Secretary to determine the kind and/or amount of air contaminants emitted from the source. Standard operating permits shall be valid for a period of one (1) year or for such time as deemed appropriate by the Technical Secretary. A permit issued for less than one year shall be designated as a temporary permit.

(5) Any person in possession of an operating permit shall maintain said operating permit readily available for inspection by the Technical Secretary or his designated representative on the operating premises. A person required by these regulations to have one or more operating permits shall keep at least one operating permit prominently and conspicuously displayed on the operating premises.

(6) Operation of each air contaminant source shall be in accordance with the provisions and stipulations set forth in the operating permit, all provisions of these regulations, and all provisions of the Tennessee Air Quality Act.

(7) The owner or operator of any air contaminant source to which any of the following changes are made, but would not be a modification requiring a

construction permit, must notify the Technical Secretary thirty (30) days before the change is commenced. These changes are:

(a) change in air pollution control equipment,

(b) change in stack height or diameter,

(c) change in exit velocity (of more than twenty five (25%) percent) or exit temperature of more than fifteen (15%) percent (absolute temperature basis).

(8) Any stack sampling report required on a construction permit is part of the operating permit application. Any stack sampling report required on an operating permit is part of the application for renewal of that operating permit.

(9) The owner or operator of any air contaminant source subject to an order or variance issued so as to allow the source by its terms to operate while exceeding an emission standard, shall pay the cost of publication of any notices (including, but not limited to, a copy of the order) required by state or federal law or regulations to effectuate the right of continued operation.

(10) Those sources possessing a valid permit on the date Chapter 1200-3-19 becomes effective and subject to a specified compliance schedule in Chapter 1200-3-19 must comply with all the requirements contained in the permit and the requirements of Rule 1200-3-9-.02 of this Chapter. All permits shall expire on the date the emission standard specified in Chapter 1200-3-19 becomes effective. If a source possessing a valid operating permit and subject to a specified compliance schedule contained in Chapter 1200-3-19 fails to comply with the specified schedule, such permit will be revoked upon notification that the source has not complied with the schedule and opportunity for hearing by the Technical Secretary.

Authority: T.C.A. Section 68-25-105 and 4-5-202. Administrative History. Original Rule certified June 7, 1974. Amended effective February 9, 1977. Amended effective March 21, 1979. Amended effective June 7, 1990.

1200-3-9-.03 GENERAL PROVISIONS

(1) Irrespective of the provisions of the preceding paragraphs of this Chapter, the owner or operator of any air contaminant source shall be responsible for complying with emission regulations as contained in other Chapters of these regulations at the earliest practicable time and for this purpose the Board shall have the authority and responsibility to require compliance with these regulations at an earlier date than indicated where such earlier compliance may reasonably be accomplished.

(2) No person shall use any plan, activity, device, or contrivance which the Technical Secretary determines will, without resulting in an actual reduction of air contaminants, conceal or appear to minimize the effects

SECTION 13

"RULES AND REGULATIONS - MEMPHIS COUNTY GROUNDWATER QUALITY

CONTROL BOARD OF SHELBY COUNTY"

be made or permitted unless the source and use of the auxilliary supply, and the location and arrangement of the intake are approved by the Department in writing.

Section 13 — INJECTION WELLS

No injection wells of any type shall be allowed in Memphis and Shelby County for the injection of surface or groundwaters, or chemically or thermally altered water, or any other fluids into the underground formations. No well constructed shall be used for recharge, injection, or disposal purposes.

Section 14 -- VARIANCES

14.01 -- Existing Wells

Wells in existence on the effective date of this act shall be required to conform to the provisions of these Rules and Regulations, or any rules or regulations adopted pursuant thereto, where such provisions relate to assessment of fees, cross connection control, improperly maintained wells, abandoned wells and wells constructed in such a way that create serious health hazards, and any other items deemed necessary by the Department.

14.02 — APPEALS — PROCEDURE

Any person who feels aggrieved by an order of the Department issued pursuant to these rules and regulations shall be entitled to a hearing before the Board upon request.

A. The Board shall have and exercise the power, duty, and responsibility to hear and decide all matters concerning a variance to or an exception taken to any decision, ruling, requirement, rule, regulation or order of the Board or the Department. Such appeal shall be made within fifteen (15) days after receiving notice of such decision, ruling, requirement, rule regulation, or order by filing a written notice of appeal directly to the Board specifying the grounds thereof and the relief requested. Such an appeal shall act as a stay of the decision, ruling, requirement, rule, regulation, or order in question until the Board has taken final action on the appeal, except when the Department has determined that a health

SECTION 6

"RULES AND REGULATIONS - MEMPHIS COUNTY GROUNDWATER QUALITY CONTROL BOARD OF SHELBY COUNTY"

be exercised to make certain that all areas of a well come in full contact with a solution containing enough available chlorine to completely destroy all pathogenic microorganisms. An initial chlorine concentration of fifty parts per million (50 ppm) with a residual chlorine requirement of twenty-five parts per million (25 ppm) after twenty-four (24) hours is considered adequate for this purpose. Domestic laundry bleaches containing sodium hypochlorite either in powder or tablet form may be used. The well shall be allowed to remain undisturbed after the treatment for a period of twenty-four (24) hours and then tested for residual chlorine. at least twenty-five parts per million (25 ppm) must remain. After successful treatment, all water remaining in the well anc supply system shall be pumped free of residual chlorine and a sample of fresh water from the well shall be collected by and tested by the Department for bacteriological purity.

5.08 -- Sampling of A Well

A. After a well has been drilled, modified, or repaired, a negative bacteriological sample shall be obtained prior to placing the well into service.

B. A well shall not be connected into a premise until a sample has been collected which produces negative bacteriological results.

C. If a sample collected from a newly constructed well is positive for E. coliform bacteria, it shall be the well driller's responsibility to take whatever steps necessary to properly disinfect the well. Two consecutive bacteriological samples producing negative results must be obtained prior to placing the well into service.

D. Whenever a well is repaired or modified. it shall be the responsibility of the well driller to notify the Department upon completion of work to sample the well for bacteriological purity. It shall be the well driller's responsibility to properly disinfect the well upon completion.

Section 6 MONITOR AND RECOVERY WELLS CONSTRUCTION STANDARDS

6.01 General

A. A construction permit is required for monitor and recovery wells.

B. All wells shall be constructed in a manner that will guard against contamination of the groundwater aquifers underlying Shelby County. No person shall construct, repair, modify, or abandon or cause to be constructed, repaired, modified, or abandoned any well contrary to the provisions of these Rules and Regulations.

6.02 Siting Criteria

When a well site is subject to flooding it shall be cased to a point at least two feet above the 100-year recurrence flood level for the area. In the case of a flush mount, the well shall have a waterproof seal with a lockable leakproof inner cap. If necessary, the area shall be filled with material approved by the Department, properly graded, and maintained to prevent the accumulation or retention of surface water.

6.03 Sanitary Protection of Wells

A. All water used in the construction of a well shall be from an approved potable water supply. Water obtained from lakes, ponds, streams, and other such surface water sources is not approved and shall not be used in the well construction process.

B. It shall be the responsibility of the well driller to protect the opening made during the drilling and to prevent any type of contamination from entering.

C. Should a well be abandoned for any reason, the well shall be filled in a manner prescribed by Section 9 of these rules and regulations.

D. Whenever construction stops before the well is grouted the open annular space shall be covered and the casing capped. The casing cap shall be either threaded onto the casing; secured by a friction type device which locks onto the casing; welded; or secured by such other device or method as may be approved by the Department. It shall be the responsibility of the Owner to maintain the integrity of the protective device placed on the well opening by the well driller.

E. A well shall be drilled to a size that will permit the outer casing to be surrounded by a water tight seal a minimum of two inches thick. All wells shall be grouted as soon as possible but not later than 24 hours after the well casing has been set in place and all drilling has been completed.

F. The grout material shall consist of a mixture of neat Portland Cement or quick setting cement and water in a ratio of six (6) gallons of water per ninety-four (94) pound sack of cement. A maximum of six (6) percent, by weight, bentonite may be added. A special condition for grouting a well may be made by the Department within the well construction permit.

G. The method of grouting the annular space of a well shall be throughout the entire length of the casing in one continuous operation from the top of the screen or bentonite seal to the ground surface. The grout mixture may be pumped from the surface when:

   (a) water will not be encountered, and
   (b) the depth is less than twenty (20) feet.

Pressure grouting is required if the aforementioned conditions are not met. Pressure grouting will be accomplished using a tremmie pipe. When the tremmie pipe is encased in the grout it must have the same protection as the casing. (refer to paragraph 6.03D)

H. The borehole shall not hydraulically connect separate aquifers.

6.04 Construction Materials And Other Requirements

A. All materials, components, parts, etc., used in the installation of a monitoring or recovery well, such as the casing, screen, pumping equipment, pressure tank, wiring, pipe, and other such components, must comply with the standards as established in the RULES OF THE TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT, DIVISION OF GROUNDWATER PROTECTION, CHAPTER 0400-4-2, entitled, RULES AND REGULATIONS PERTAINING TO GROUNDWATER DEVELOPMENT AND THE LICENSING OF WATER WELL CONTRACTORS AND PUMP SETTERS. When deemed necessary, the Department may require standards and specifications to be more stringent than those required by the State of Tennessee.

B. The well shall be backfilled to a point, a minimum of two (2) feet above the top of the screen with filter sand, followed by a minimum of two (2) feet bentonite pellet seal above, which shall be grouted in accordance with Section 6.03.

C. All piping materials shall be flush joint and threaded pipe. No solvent weld cements or other compounds shall be allowed. End points shall have threaded ends or be riveted on. Slip on ends are not allowed. Top caps shall be threaded or have some type of locking feature.

D. Bentonite pellets shall have a maximum size of 1/4 inch to prevent bridging and shall then be activated with potable water.

6.05 — Protection of the Well

A. A lockable cover shall be provided at the terminal of all well casings, and shall be so designed as to prevent any contamination from entering the well.

B. When a well site is to be subject to flooding it shall be cased to a point (1) at least two (2) feet above the 100-year recurrence flood level for the area, or (2) in the case of a flush mount, have a waterproof seal with a lockable leakproof inner cap. When necessary, the area shall be filled with material approved by the Department, properly graded, and maintained to prevent the accumulation of retention of surface water.

C. Until the well is abandoned and closed in accordance with these regulations, that portion of the well above the ground level shall be protected against tampering or destruction.

6.06 — Maintenance of Wells

A. Wells shall be maintained in an operative condition at all times in order for water samples to be collected for analytical purposes and shall have at least one (1) keyed lock to prevent tampering.

B. All wells shall be maintained in a condition whereby they are not a hazard to health or environment nor a source of contamination to the groundwater aquifers.

C. When a well is determined to be abandoned as defined by these rules and regulations, the owner shall be ordered to seal the well in accordance with the requirements of Section 9 of these regulations.

Section 7 — SOIL BORINGS

7.01 -- DEFINITION OF SOIL BORINGS

Any hole that is drilled, cored, dug, washed, driven, jetted, redrilled, bored, or otherwise constructed, for the purpose of determining geological formations, water level, or for the purpose of founding structures.

APPENDIX E

LIST OF VENDORS AND MANUFACTURERS CONTACTED

Hadley Indutries
5900 West Fourth Street
Ludington, MI 49431
800/345-4227

Met-Pro Corporation
Duall Division
1550 Industrial Drive
Owosso, MI 48867
517/725-8184

North East Environmental Products
17 Technology Drive
West Lebanon, NH 03784
603/298-7061

ULTROX
2435 South Anne Street
Santa Ana, CA 92704-5308
714/545-5557

Dear Customer:

Thank you for your interest in stripping tower systems designed by Met-Pro Corporation Duall Division. I have enclosed the product information which you requested.

Our stripping tower systems are designed to remove the odorous substances and VOC's from the influent water stream. Duall manufactures the fans, duct, and towers for such systems from PVC and polypropylene for corrosion-resistant service.

Met-Pro Corporation Duall Division has the experienced, multi-disciplined professional staff to aid in the design, installation, and monitoring of your air pollution control equipment. Our field technical service offers inspection and upgrading of existing equipment and addition of electrochlorination systems for on-site hypochlorite generation.

Servicing the industry since 1964 with more than 8,700 installations, Duall will provide you the benefit of our experience in air pollution control technology. We look forward to the opportunity to serve you. If you have any questions please call.

Very truly yours,

MET-PRO CORPORATION
DUALL DIVISION

211-43ST / 012492

BULLETIN 101-892

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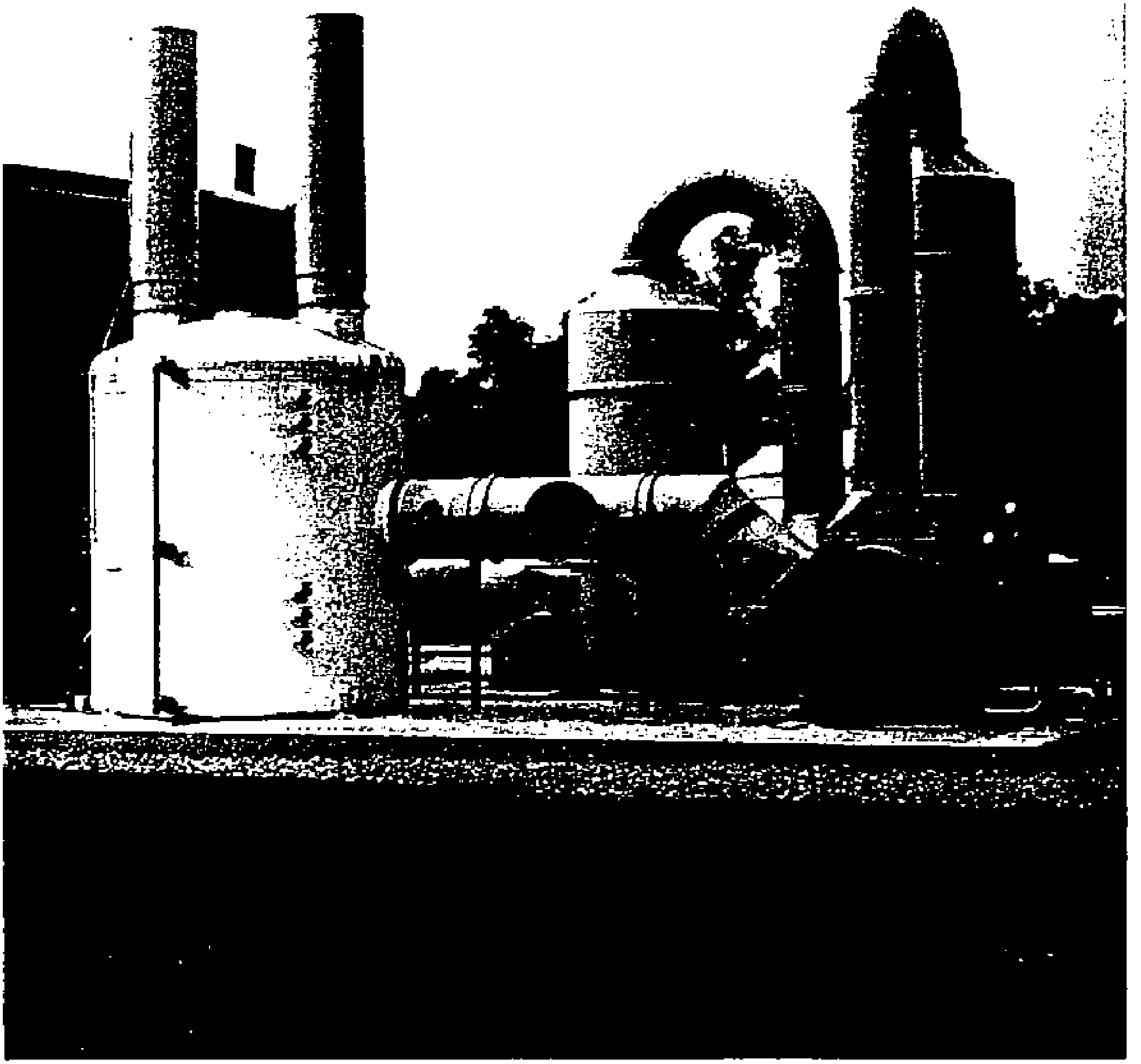
GENERAL PRODUCTS

POLLUTION CONTROL SYSTEMS,
SCRUBBERS, AIR STRIPPERS,
VENTILATION DUCTS,
HOODS AND FANS,

MET PRO CORPORATION **Duall Division**



Odor Control Systems

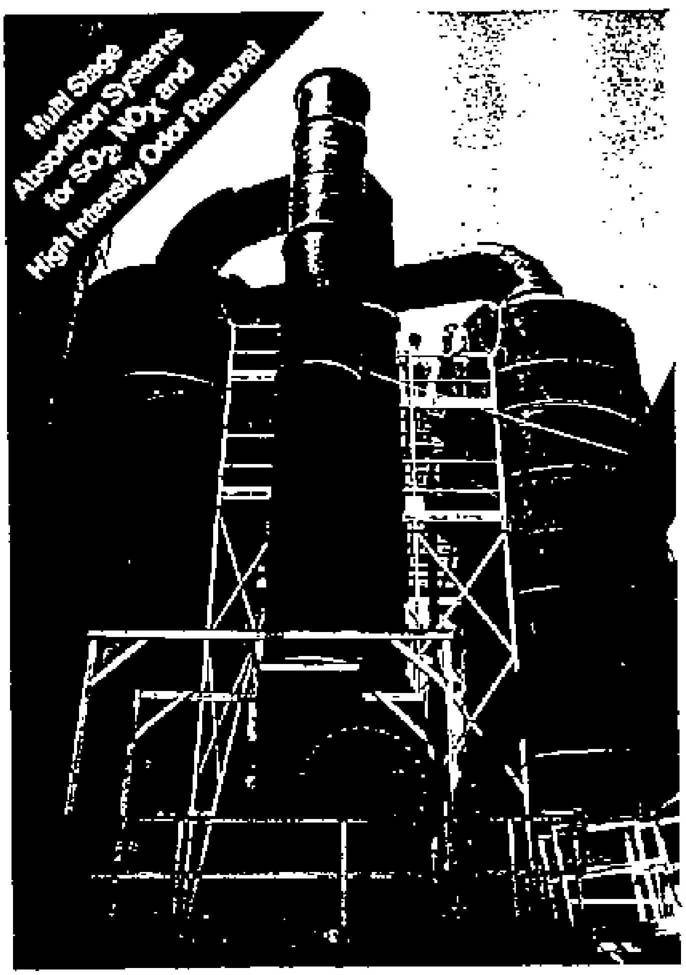
Duall designs, on a day-to-day basis, customized odor-control scrubbers to meet customer specific needs. Through the use of an in-house computer, in conjunction with a highly trained lab and chemical engineering staff, Duall can design a unit to meet even the strictest requirements. Major design criteria evaluated include: size of unit, filter packings, moisture extractor, scrubbing liquid, GPM required, and material of construction.

Services Offered

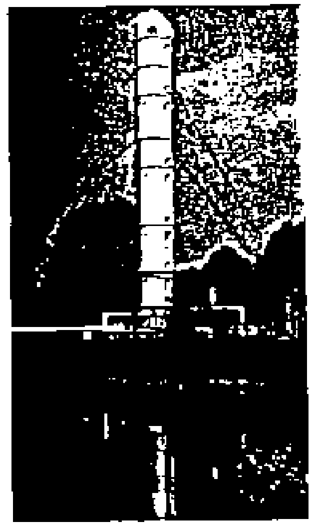
- Determine the problem
- Determine the necessary degree of control
- Select the best method of control
- Select the proper chemistry
- Design for minimum air volume
- Provide field services, engineering, installation, start-up, and operator training

Typical Applications

- Industrial wastewater treatment
- Municipal wastewater treatment
- Food processing
- Chemical industries
- Rendering
- Refineries
- Medical
- Foundries
- Fish processing
- Breweries
- Animal food
- Pesticides
- Pulp and paper
- Tanning
- Pharmaceutical
- Textile
- Painting



Stripping Towers



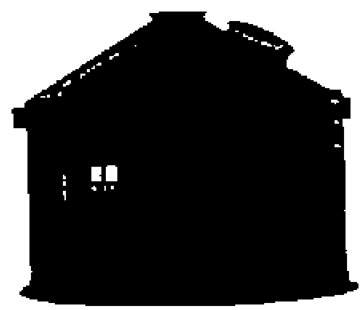
Duall stripping towers remove Volatile Organic Compounds(VOC's) found in groundwater supplies, industrial wastewaters and process effluents.

Each stripping tower is computer-designed from an extensive data base. On-site testing is utilized when necessary.

Advantages

- Easily modified for future changes
- Easily cleaned and maintained
- Long service life
- Simple operation
- Easy installation
- Corrosion-resistant construction
- Computer designed from extensive data base
- Optional carbon absorbers for polishing are available when required
- Low pressure drop

Activated Carbon for Odor Control & VOC Removal



- Eliminates residual odors emitted from municipal and industrial processes
- Removes "difficult to treat" odors and eliminates remaining organic compounds from exhaust

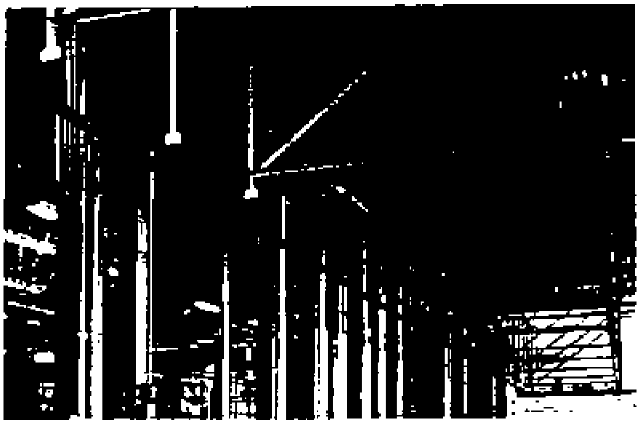
Typical Contaminants Removed

- Hydrogen sulfide
- Mercaptans
- Sulfur dioxide
- Organic acids
- Volatile organics(VOC's)
- Ammonia*
- Amines

*Virgin carbon recommended

Features and Benefits

- Vertical, cylindrical vessels, from 2' to 12' diameter
- Capacity to 1300 CFM, larger units available upon request
- Pelletized carbon provides lower pressure drop
- Single and dual bed adsorber



Duct, Hoods & Other Specialty Thermoplastic Fabrications

Duall duct, hoods and tanks are designed for each application in accordance with standards set by the American Conference of Governmental Industrial Hygienists and OSHA.

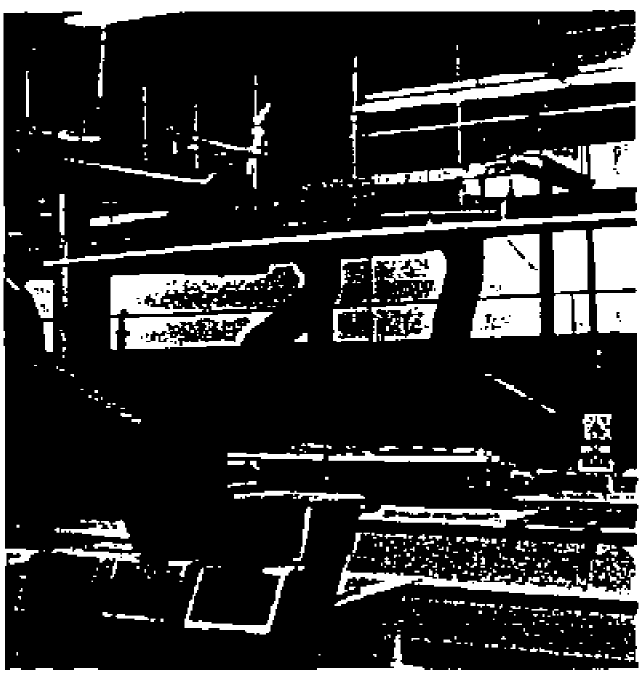
Duall determines the amount of air required at each source affecting hood slot size, size of hood plenum and size of duct.

The best corrosion-resistant material for construction is selected for duct and hoods using the highest quality PVC, CPVC, PP, PVDF, HDPE, FRP and PVC/FRP overlay.

Duall has the highest standards and the most advanced equipment for manufacturing .

Advantages

- Lightweight for ease of installation
- Computer designed
- Best corrosion-resistant material for application
- Highest manufacturing standards
- Designed and manufactured to ACGIH and SMACNA Standards



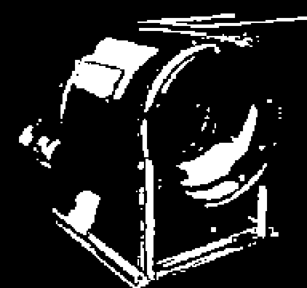
Centrifugal Fans

Duall offers a wide selection of corrosion-resistant centrifugal fans to handle even the most difficult applications. Standard materials of construction are fiberglass reinforced plastic (FRP), polyvinyl chloride (PVC), and polypropylene (PP). Optional materials of construction are polyvinylidene fluoride (PVDF), polyethylene (HDPE), high temperature PVC (CPVC) and stainless steel.

Advantages

- 100% corrosion-resistant
- 40 to over 60,000 CFM available
- FB Models up to 14" S.P.
- Temperatures to over 200° F
- Electronically balanced
- Rugged construction
- Quiet operation
- Quick, easy installation
- High efficiency, economical operation
- Low maintenance

Type FB Centrifugal Fan—1,000 to 60,000 CFM



Type NH Centrifugal Fan 500 to 60,000 CFM

Type FR Centrifugal Fan—150 to 2,800 CFM

Type CI Centrifugal Fan 300 to 3800 CFM

Type LF 8TD Lab Fan 40 to 700 CFM

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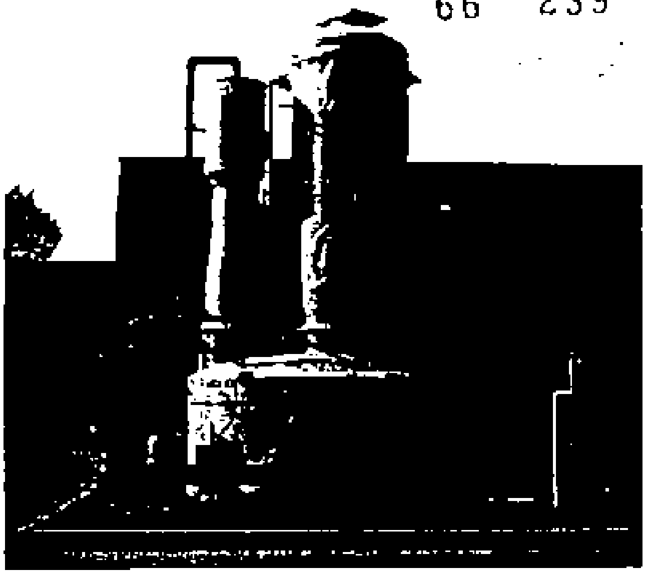

Emergency Gas Scrubbers

- No external fan required—maximizes reliability and minimizes capital and maintenance costs
- Excellent for treatment and control of sudden releases of toxic gases
- Especially useful in the water treatment and chemical process industries
- Combine the particulate removal and gas moving features of an ejector with the gas absorption quality of a packed tower

TYPICAL APPLICATIONS

- Sulfur dioxide
- Ammonia
- Chlorine

SPECIAL FEATURES

- Gas detection available for selected applications
- Flow rates from 50 — 10,000 CFM
- Corrosion resistant construction available in PVC, polypropylene, fiberglass and a variety of dual laminates
- Particulate removal
- Self-contained recirculation

Ejector Tower Scrubbers

Compact, highly efficient scrubbers designed for vapor deposition reactors, cylinder cabinets, chemical storage tanks, chlorine scrubbing and low- volume exhaust applications.

- Ideal for particulate removal
- No external fan
- Flow rates to 300 CFM in standard models
- Skid mounted
- Self contained recirculation
- Stationary or portable installations
- Minimum hook-ups—fresh water, drain, electrical power, chemical feed
- pH and ORP control packages available
- Fittings to connect nitrogen purge gas
- Full one-year warranty

A Partial List of Duall's Major Customers

Tinker Air Force Base
Oklahoma City, OK

RCI, Riviera Beach, FL

Regional Wastewater Facility
Cape May County, NJ

Sanders Brothers Co.
Overland Park, KS

Airco
Research Triangle Park, NC

Pratt & Whitney
Bridgeport, WV

Midwest Aluminum
Kalamazoo, MI

Xerox, Webster, NY

Greenwood Plating
Greenwood, SC

Allied Finishing
Grand Rapids, MI

Eastern Radiation Env.
Montgomery, AL

IBM Material Distribution Center
Endicott, NY

AT&T Solid State Tech.
Upper Macungie, PA

Chem-Tronics, El Cajon, CA

Keeler Brass
Grand Rapids, MI

Lakeland City Wastewater
Treatment Plant
Lakeland, FL

McGraw-Edison
Albion, MI

Tusas Aerospace Ind.
Istanbul, Turkey

Kelco Div. of Merck & Co
San Diego, CA

Unarco, Wagoner, OK

Town of Westerly
Westerly, RI

Anomatic
Westerville, OH

Pacific Chloride
Columbus, GA

Peace Sun Pkg. "G" Project
Taif, Saudi Arabia

American Can,
Graphics Center
Battle Creek, MI

City of Detroit
Water & Sewer
Detroit, MI

IBM, Tech. Development
Endicott, NY

Raytheon Co.
Waltham, MA

Caterpillar
Aurora, IL

Columbia Intl. Ltd.
Longueuil, Quebec

TRW Aircraft Components
Minerva, OH

Philips Labs
Briarcliff Manor, NY

Ford Motor Co.
Mt. Clemens, MI

Birdview Satellite
Olathe, KS

Stanley Plating
Forestville, CT

MacDermid, Inc.
Waterbury, CT

Automata, Inc.
Reston, VA

Wang Labs
Methuen, MA

Teradyne Inc.
Nashua, NJ

Isotronics, Inc.
New Bedford, MA

King Radio, Olathe, KS

Goetze
Manitowac, WI

Avco Systems Div.
Wilmington, MA

Gillette Co.
Boston, MA

United Tech.,
Sikorsky Aircraft
Stratford, CT

MacDermid, Inc.
Ferndale, MI

Douglas Aircraft
Torrance, CA
Long Beach, CA

G. A. Technology
San Diego, CA

Cardinal Aluminum
Louisville, KY

Charleston Naval Shipyard
Charleston, SC

El Paso Wastewater
Treatment Plant
El Paso, TX

Indian Creek
Kansas City, MO

Cooper Industries
Missouri City, TX

Chautauqua Wastewater
Treatment Plant
Chautauqua, NY

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Problem Solving

People – the heart of the company– dedicated to the design, production and servicing of quality products, ensuring our reputation for excellence.

People – with experience in all facets of business, from management, engineering, sales, and production through installation. Not just keeping pace with the industry but providing leadership. The longevity of our employees is a testimony to our commitment and assurance of quality. It is considered to be a personal challenge to this company to solve your problems through this breadth of experience.

Experienced Local Representatives

- Trained air-pollution specialists
- Over 50 offices nationwide plus international representation

In-House Engineers

- Dedicated professional staff—chemical, civil, mechanical engineers

Project Engineers

- Extensive background—engineering, manufacturing, installation
- Total responsibility from order through shipment and beyond

Manufacturing Personnel

- Highly trained, motivated and quality conscious employees

Trained Installers

- Experienced personnel—basic supervision with full turn-key capabilities

Quality Assurance

Corrosion-resistant, warranted air-pollution control equipment and ventilation systems. These products offer long life and proven performance at affordable prices, and are your assurance of satisfaction in meeting the requirements of specifications and governmental regulations.

Wet Scrubbers

- Standard or custom-engineered models, wide selection, high efficiency, corrosion-resistant, long life, low water consumption, minimum maintenance.

Corrosion Resistant Fans

- Broad performance, quiet operation, rugged construction, electronically balanced

Duct Systems—Exhaust Hoods

- Efficiently designed, energy-conserving, corrosion-resistant, lightweight, attractive

Oil Mist Eliminator

- Efficient, compact, self-powered, versatile.

Chemical Mist Eliminator

- Standard or custom-engineered models
- Dry or wet operation

Air Stripping Towers

- Removes Volatile Organic Compounds (VOC's) from groundwater.

Efficiencies

Modern labor-saving facilities enable Duall to be a leader in the design and development of new and improved fabrication methods, keeping your costs low. Two manufacturing plants insure timely delivery of your order

- Over 60,000 square. ft., labor-saving equipment, research and development laboratory

Total Service

More than an equipment producer, Duall emphasizes the total service approach to customer problems. Dedication to customer satisfaction is the hallmark of Duall's service policy. After-the-sale service is important, and Duall provides it on a highly professional level.

Customer Services

- Specification writing assistance, system design, field management, installation, start-up, operation and maintenance training, warranty service.

Special Services

- Pilot studies, on-site testing, lab studies
- Air permit assistance
- Design/build engineering

11-5000 892

Represented by:

MET PRO CORPORATION **Duall Division**

1550 INDUSTRIAL DRIVE, OWOSSO, MI 48867
(517)725-8184, FAX (517)725-8188

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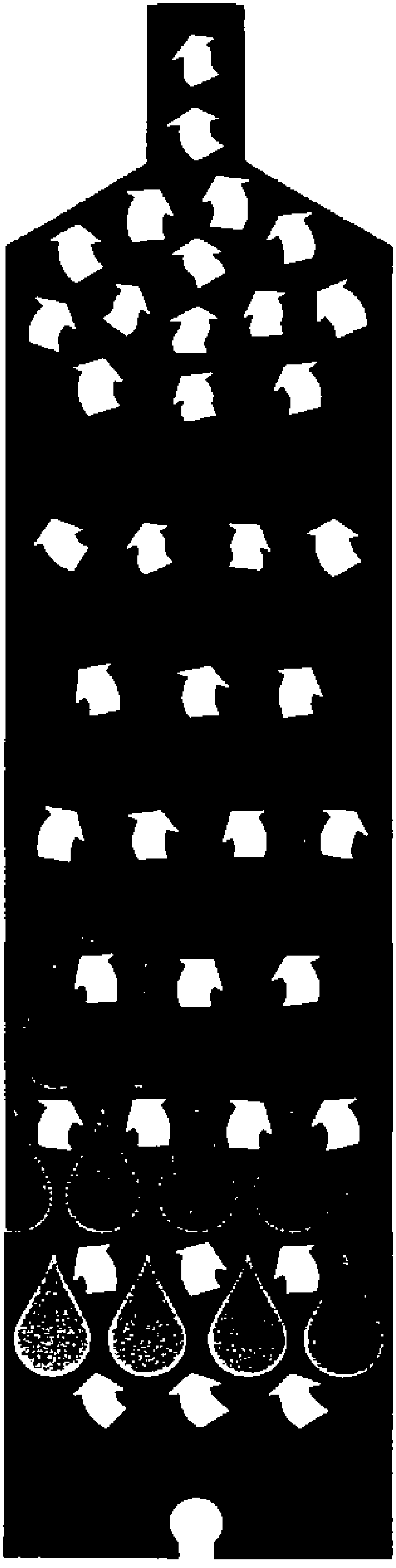
Duall

AIR-STRIPPING COLUMNS



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DUALL experience saves time and money from specification to start-up

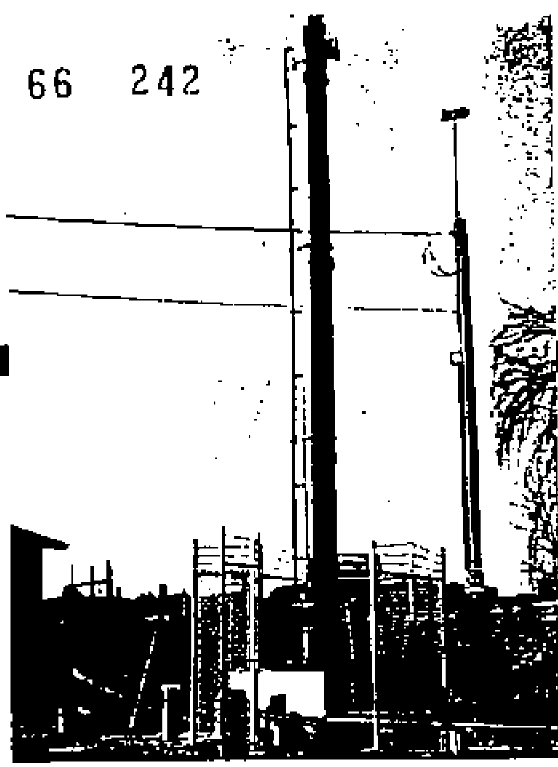
The ready availability of potable water is one of our most pressing problems. Evidence is increasing that the supply is shrinking, and more and more of the available water is contaminated with volatile organic compounds (VOC's), usually chlorinated solvents. Consumer pressure, as well as governmental regulations — federal, state and local — are demanding effective and prompt action to preserve water availability for both human and industrial use. Duall is in a unique position to meet the industry's needs for efficient, cost-effective VOC removal.

Many organic compounds are found in groundwater supplies, industrial wastewaters and process effluents. Some dissolved gases, hydrogen sulfide, ammonia and CO_2 occur naturally; still other manufactured chemicals are found as contaminants. There are hundreds of potential pollutants that may be removed by air stripping. The ease of stripping depends on a particular compound's vapor/liquid equilibrium constant (VLE). In turn the VLE is influenced by temperature, other contaminants present and general chemistry of the water.

More and more engineering firms and consultants rely on Duall's many years of mass transfer experience. We work closely with the project manager to ensure that our portion of a complete system performs as expected. We do not compete with Design/Engineering Service Firms — rather we enhance the project manager's success by providing our expertise and experience in pollution control technologies and equipment.

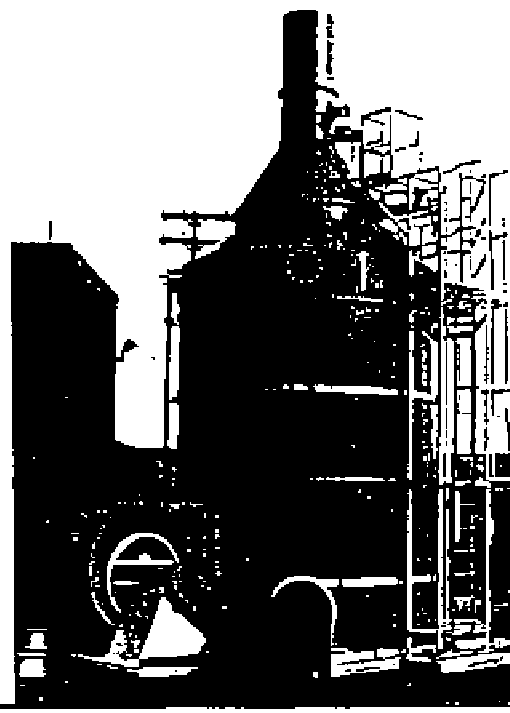
The result of this cooperation is the "optimum" stripping column system, neither over- nor under-engineered. It will deliver the required efficiency at the required liquid capacity (from 5 gpm to 3000 gpm), while operating at minimum pressure drop. Duall stripping columns are fabricated of corrosion-resistant materials, facilitating ease of cleaning and maintenance. These strippers can be readily modified to meet future requirements. Turnkey installation is available, with on-time delivery, optimum energy efficiency and a one-year warranty.

Clearly, the Duall way is the efficient way — in completeness of design, economy, delivery, performance, and satisfaction.

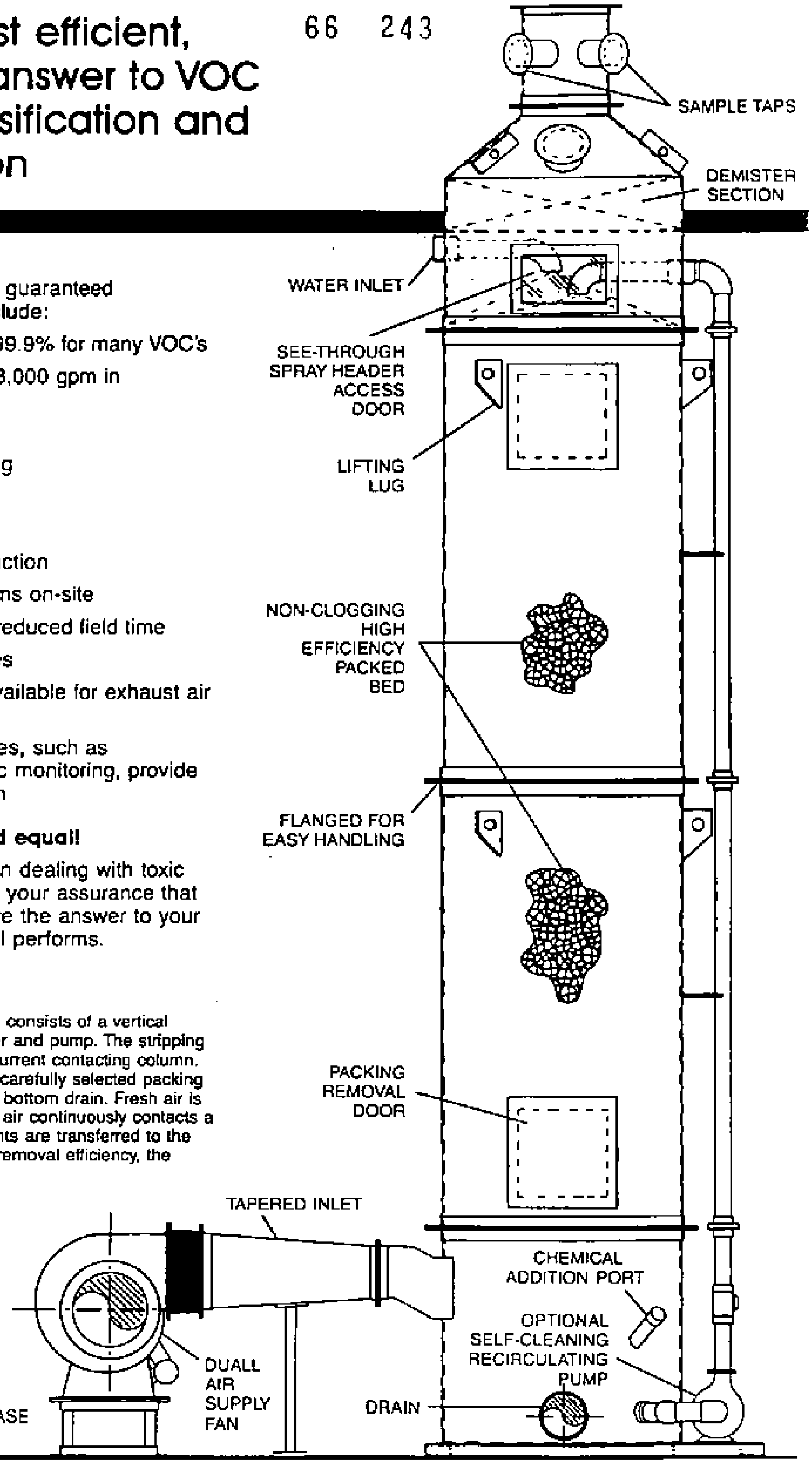


A typical PVC-constructed air stripping column, designed for 99.9 percent removal efficiency of 1,1,1-trichloroethane, toluene and trichloroethylene from a 20-25 gpm well source. This 28' tower was provided complete, with self-cleaning option and motor starter control panel. System was in operation three weeks after design approval. The tower operates year-'round at a site on the east coast. Performance exceeds requirements.

One of the largest single tower stripping columns in operation in this country, this Duall unit was designed to remove TCE and other VOCs to less than 1 part per billion. It consistently performs above specifications. The 12'6" diameter by 30' high stripper processes from a 3,000 gpm well water source. The unit features high efficiency packing and all PVC construction. Two PVC fans provide the air supply; one fan is for emergency backup. Starter and alarm panels were supplied by Duall, as was installation and start-up service.



Here is the most efficient, cost-effective answer to VOC removal, degasification and odor elimination



Buy only what you need with guaranteed performance. Advantages include:

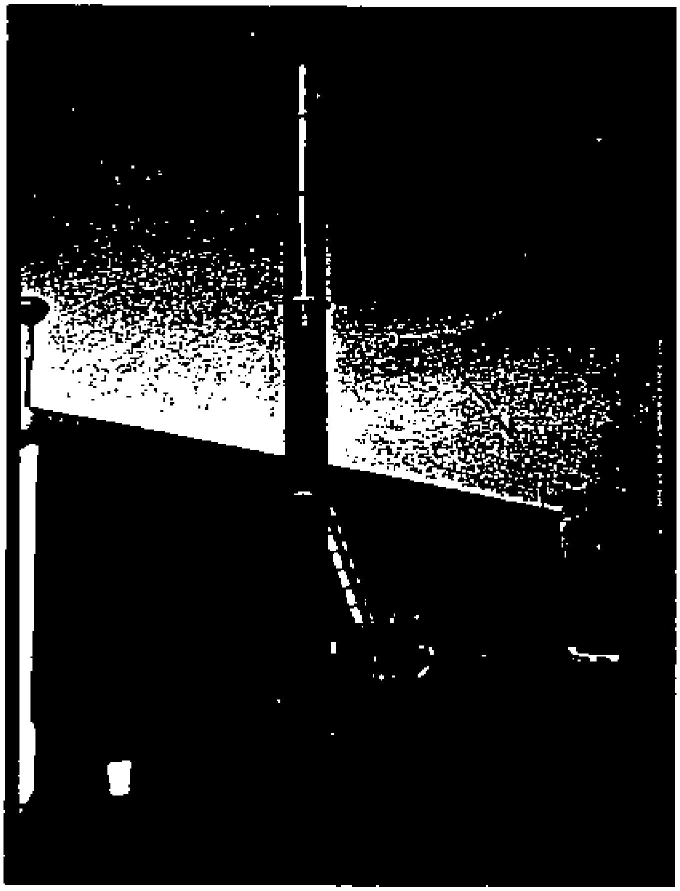
- Removal rates exceeding 99.9% for many VOC's
- Capacities from 5 gpm to 3,000 gpm in single-column applications
- Computer design
- Laboratory feasibility testing
- Pilot testing services
- Rental columns available
- Corrosion-resistant construction
- Complete packaged systems on-site
- Rapid field assembly and reduced field time
- Installation start-up services
- Carbon adsorption units available for exhaust air purification
- Many other optional features, such as self-cleaning and automatic monitoring, provide safer, unattended operation

All columns are not created equal!

You cannot afford failure when dealing with toxic chemicals. Our experience is your assurance that Duall air stripping columns are the answer to your VOC removal problems. Duall performs.

A typical Duall Air Stripping System consists of a vertical packed tower with a fresh air blower and pump. The stripping process is carried out in a countercurrent contacting column. Polluted water is distributed over a carefully selected packing material and cascades down to the bottom drain. Fresh air is forced up through the packing. The air continuously contacts a large water surface and contaminants are transferred to the air. In order to achieve the desired removal efficiency, the thermodynamic processes must be matched to the proper column characteristics. Such important variables as column loading, gas-to-liquid ratio, temperature, air distribution and others must be considered to produce an optimum column. Duall uses a computer simulator, calibrated from actual field tests to design *every* column.

Duall provides installation service to assure on-site performance



Duall's concern with efficient design and construction does not end with shipment to the customer. We provide installation service as an extension of our expertise in system engineering. Duall-supplied columns, whether pilot or permanent, are quickly erected at the jobsite from factory matchmarked components. Winter/summer operating data and actual field performance testing allows Duall to offer performance guarantees.

NOTE: Activated Carbon or Catalytic decomposition may be required to meet air emission standards. Selection of air emission control depends on many factors. In general, the tower design must be optimized if air emission controls are required. Heating the water or air may be desirable to reduce total cost of owning and operating the system. All services are reasonably priced. Contact Duall for your air-stripping needs.

Duall
INDUSTRIES, INC.

Main Office:

700 S. McMillan Street
Owosso, MI 48867-0769
Telephone: (517) 725-8184
Telex 22-8532

102 Hillside Drive
Forest City, NC 28043-1000
Telephone (704) 245-8725
Telex 80-2210

REPRESENTED BY:

ShallowTray
low profile air strippers

You requested more information...

Enclosed is material that describes our modular line of **ShallowTray**™ aeration systems for stripping volatile contaminants from water.

The systems - using simple, patented ShallowTray technology - come in a variety of models for treatment rates ranging from 1 gpm to 200 gpm*. Removal efficiencies (based on your site's effluent requirements) are achieved by adding trays.

Each unit is typically fabricated from stainless steel and instrumented to your specifications. Molded polyethylene residential Point-Of-Entry models and 1-12 gpm groundwater remediation systems are also available.

Please call me if we can assist you in removing VOC's or Radon from water...or if you would like a proposal that is specific to your project.

Sincerely,

Barry Clarke
Customer Service

Enclosures

*Designs for greater treatment rates on request.

North East Environmental Products 17 Technology Drive West Lebanon NH 03784 (603) 298-7061 Fax (603) 298-7063

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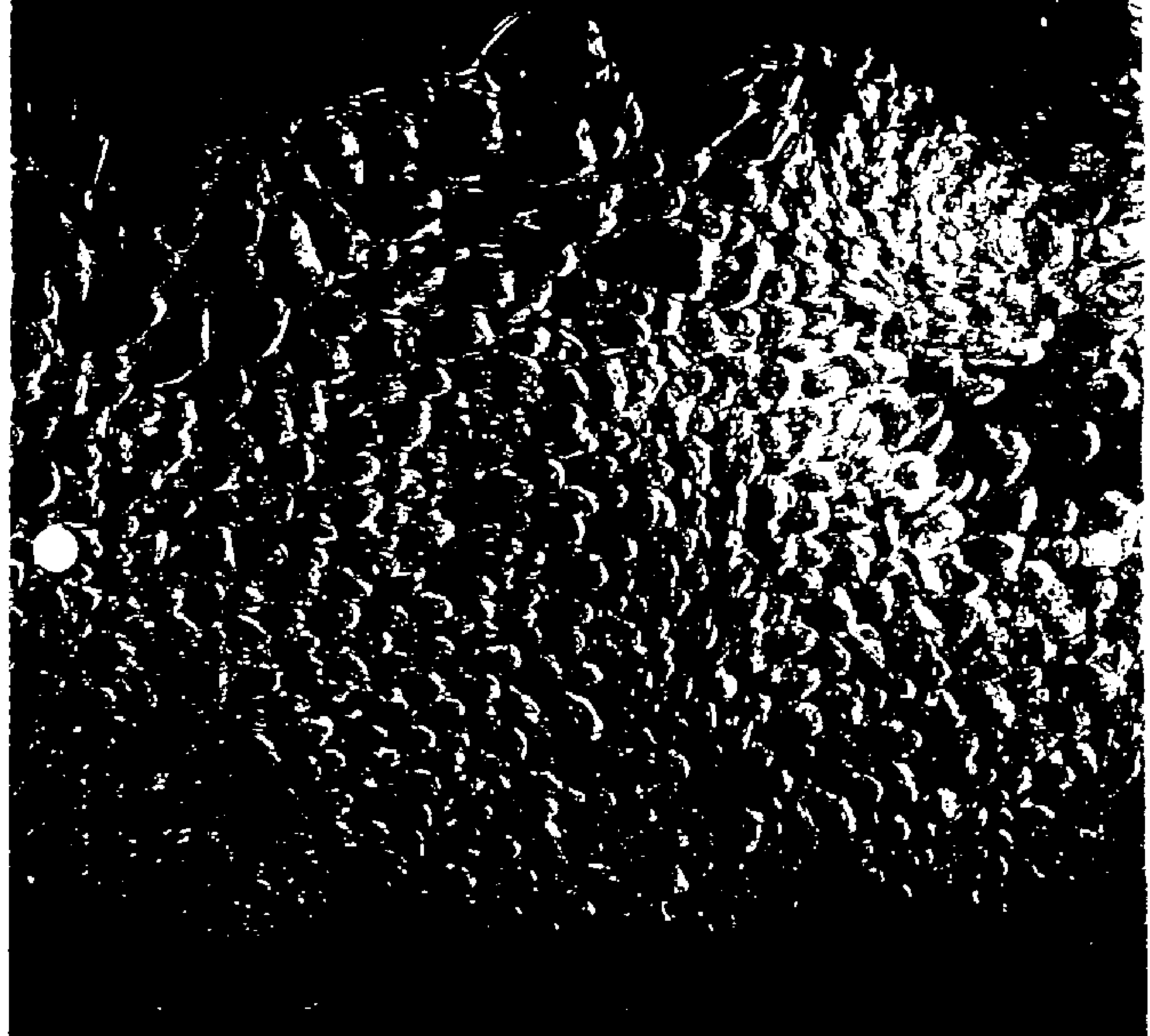

The ShallowTray™ Process

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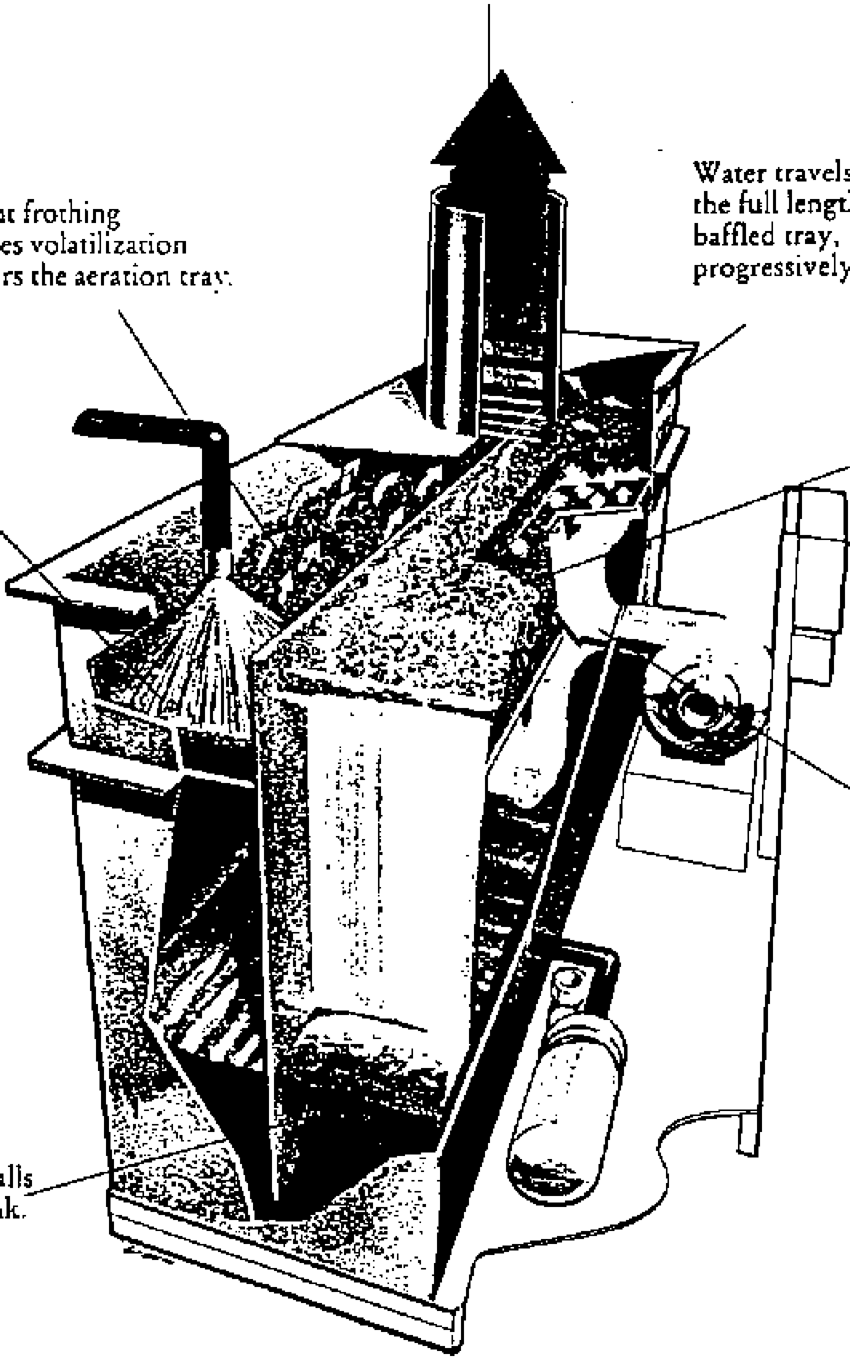

This illustration is representative of the ShallowTray™ Model 2611.

Protected under U.S. Patent No. 5,045,215. Other U.S. and International Patents Pending.

Photo on front cover: top view of 2300 Series aeration tray in action.
Photo on back cover: cross section of a ShallowTray in action (full scale).

Printed on recycled paper
#3 September

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Low Profile

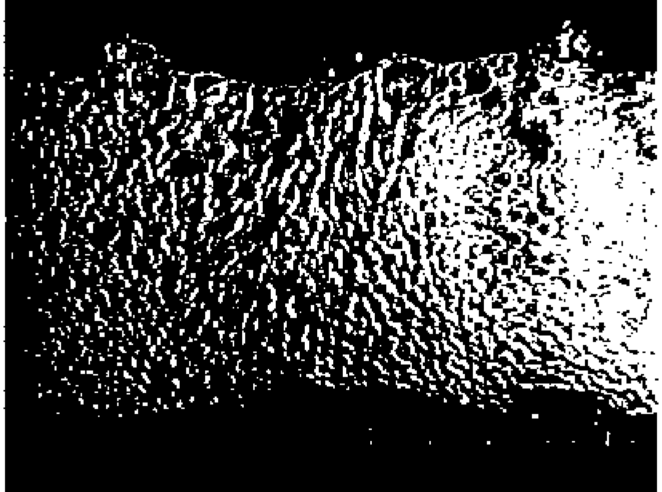
The discreet size of a ShallowTray™ air stripper does not advertise a contamination site. It is easily accessed for maintenance and can be installed inside a building. The system is also ideal as a trailer-mounted, portable stripper for pump tests, pilot studies, short-term cleanup, or emergency response. There is no tower.

Treatment

The ShallowTray process uses forced draft, countercurrent air stripping through baffled aeration trays to remove volatile organic compounds from water.

Contaminated water is sprayed into the inlet chamber through a coarse mist spray nozzle. The water flows over a flow distribution weir and along the baffled aeration tray. Air, blown up through 3/16" diameter holes in the aeration tray, forms a froth of bubbles generating a large mass transfer surface area where the contaminants are volatilized. The necessary contact or residence time to reach required volatilization is achieved through model size, addition of trays, and flow rate selection.

The air forms a froth of bubbles approximately 6 inches deep on the aeration tray, generating a large mass transfer surface area where the contaminants are volatilized.



Air is blown up through hundreds of 3/16" diameter holes in the aeration tray.

Resistant to Fouling

ShallowTray systems are resistant to fouling problems. Treatment trays have large 3/16" diameter aeration holes. In addition, the turbulent action of the froth scours the surfaces of the tray reducing build-up of oxidized iron.

If, under extreme conditions, oxidized iron accumulates or hardness begins to scale up, trays can be easily cleaned through ports using a washing wand and pressure washer. Trays can also be easily removed for a thorough inspection and cleaning.

Full Range Turndown

Not only are ShallowTray systems forgiving of "surprise" inorganics in the water, they also allow operation anywhere within the rated flow range. In fact, as the flow rate is reduced, performance increases. Also, as demands change (stricter effluent contaminant levels) so can the ShallowTray system. Its modular design allows for the addition of trays which increase the percent removal of contaminants.

No Disposal

ShallowTray systems have no packing or diffusers to contend with and no costs associated with GAC breakthrough, fouling or disposal and replacement.

System Size

To determine the system size required for your site, first identify the flow rate. This guides you to the ShallowTray Series needed. As an example, with a flow rate of 30gpm, select the 2600 Series, which is rated for flows from 1 to 50gpm.

Next, identify the contaminants present and the removal requirement. Generally, this determines the number of trays required. However, the graphs in this brochure should be used as a guideline only. For a proposal, send us or your representative the specifications. Request for Quotation sheets are available.

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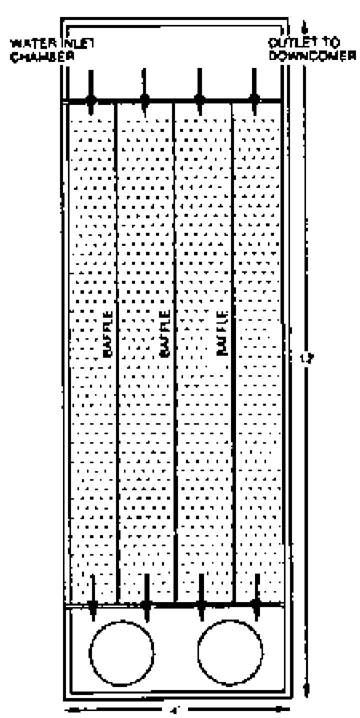
Models	flow rate	# trays	width	length	height	min. cfm	approx. lbs.
41211	1-200gpm	1	6'10"	12'6"	6'3"	1800	2875
41221	1-200gpm	2	6'10"	12'6"	7'3"	1800	3220
41231	1-200gpm	3	6'10"	12'6"	8'3"	1800	3565

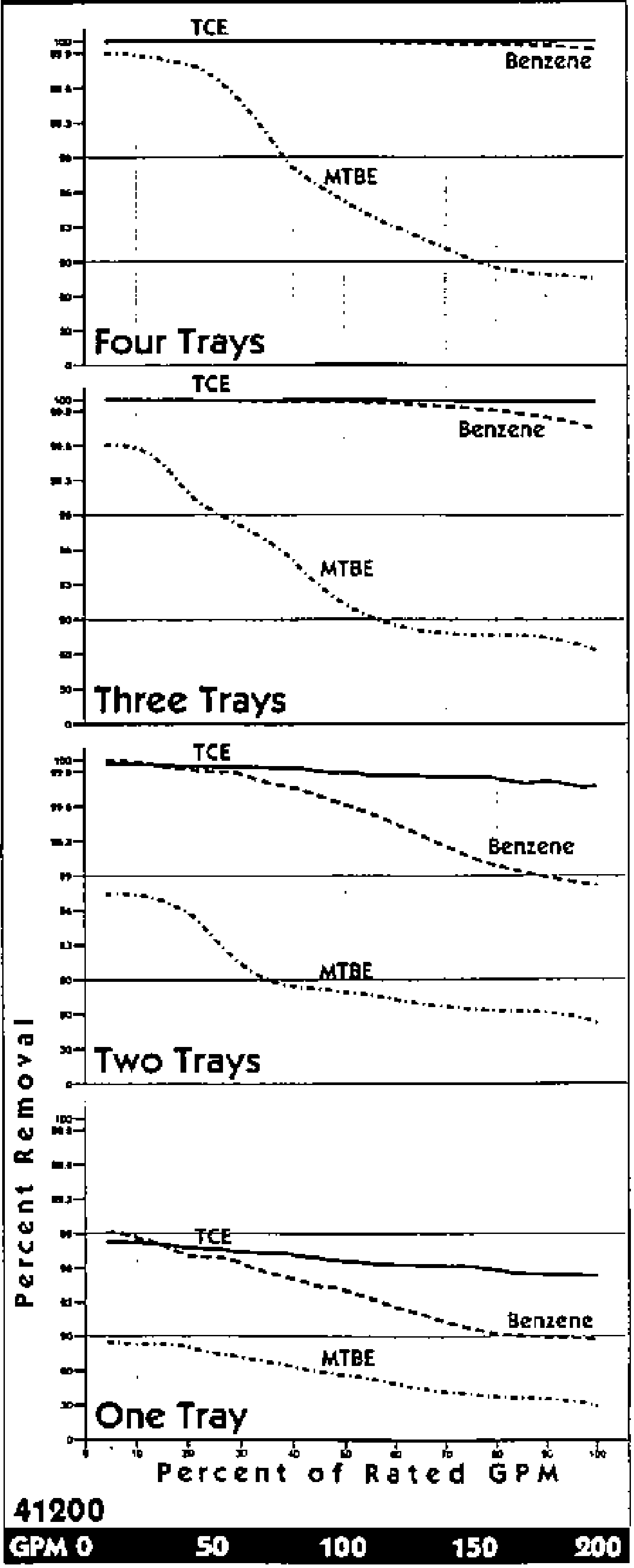
ShallowTray™
low profile air strippers

41200 AERATION TRAY



TOP VIEW

Percent Removal vs. Flow Rate



The graphs represent approximate removal efficiencies. Use the ShallowTray™ modeling program to calculate expected performance.

ULTROX

A Division of Resources Conservation Company

2435 South Anne Street
Santa Ana, CA 92704-5306
Phone: 714 545-5557
Fax: 714 557-5396

December 3, 1992

Mr. Dan Currenze
Engineer Science
425 Woods Mills Road South, Suite 150
Chesterfield, Missouri 63017

Dear Mr. Currenze:

It was good talking with you today. Literature on ULTROX® advanced oxidation processes has been enclosed, as you requested.

Ultrox processes provide solutions to complex environmental problems by destroying air and water borne toxic organics on-site, thereby eliminating the potential residual liability associated with older technologies. The patented ULTROX® process utilizes ultraviolet light with ozone and hydrogen peroxide to destroy a wide range of organic compounds in water, including many on the EPA's priority pollutant list. Phenols, aromatic solvents, including BTEX, M.T.B.E., chlorinated solvents, PCBs, PCP, explosives in water and pesticides, are examples of toxics that are destroyed in ULTROX® systems.

ULTROX® processes overcome the problems associated with other treatment methods, as the ultimate products of the process are trace salts, CO_2 and H_2O. In contrast to air stripping or activated carbon, no toxics are emitted to the atmosphere or adsorbed onto media which require landfill disposal or regeneration. ULTROX® processes can be run continuously or intermittently, which is an advantage over biological processes that are affected adversely by variations in flow rate or contaminant type and concentration.

Commercial application of advanced oxidation technology began over ten years ago with the installation of an ULTROX® system at IBM's Boulder, Colorado, facility. Acceptance of ULTROX® technology has grown rapidly, with commercial systems in operation at many Fortune 500 companies today. Installed system capacities vary from 1.0 G.P.M. to 1100 G.P.M., with total installed processing capacity in excess of 1.2 billion gallons per year.

System specifications are developed on the basis of extensive laboratory and commercial application data bases and/or bench scale treatability studies conducted at our laboratory facilities. Skid-mounted pilot plant units also are available for use at the customer job site to acquire additional design data when necessary.

ULTROX® systems are manufactured for lease or outright purchase. Rental units also are available for short-term clean up applications. Full service maintenance contracts also are available on request.

ULTROX® processes are used as a stand-alone treatment process or as part of a treatment train in tandem with processes such as ultrafiltration, biotreatment, activated carbon or metals removal. ULTROX® equipment and service is guaranteed to provide the performance required to ensure that the end user consistently remains in compliance with their regulatory guidelines.

Thank you for your interest in ULTROX® Advanced Oxidation Processes. Please contact us if you have any questions.

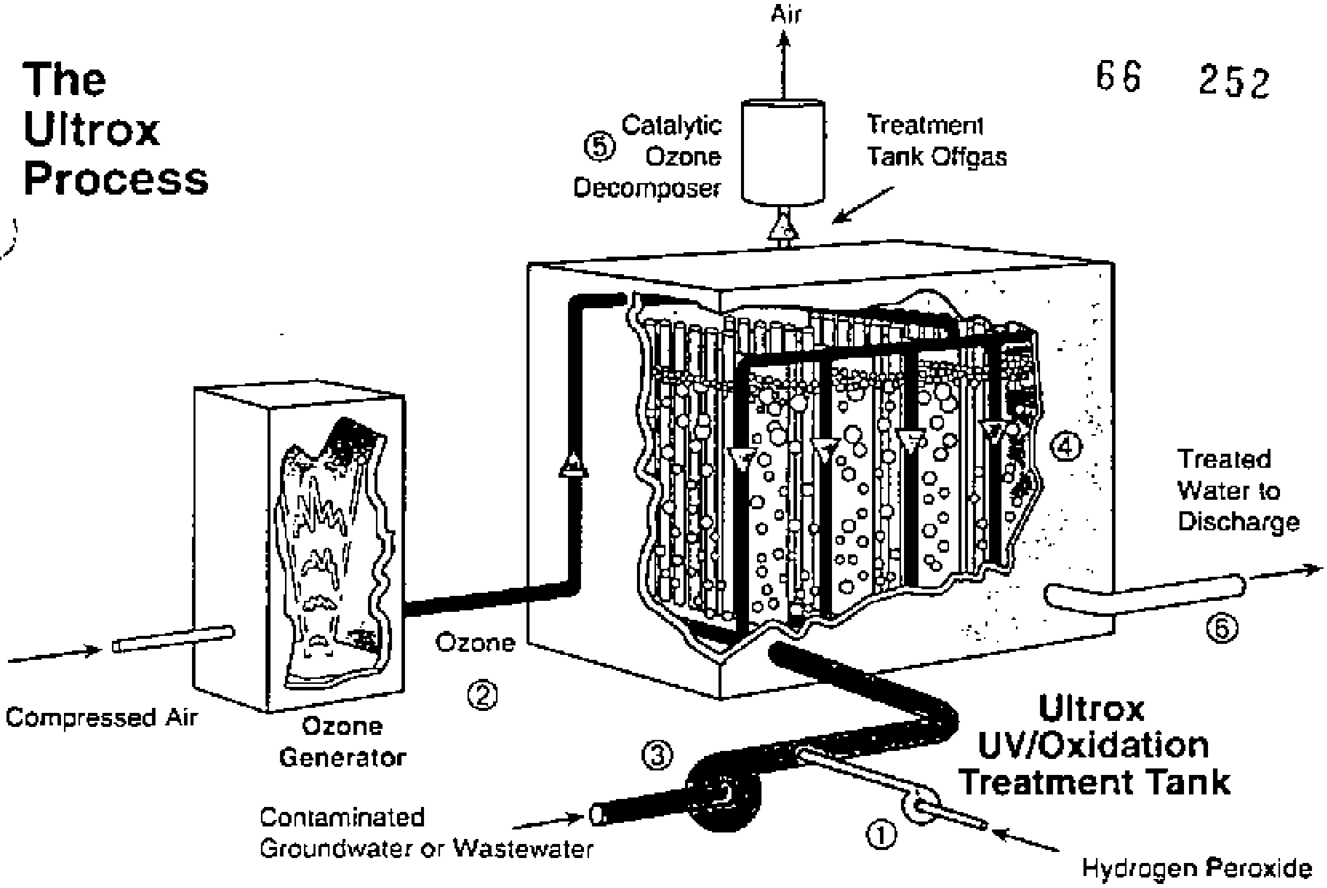
Sincerely,

William S. Himebaugh

William S. Himebaugh
National Sales Manager

WSH/mms
Enclosure: Literature Package

The Ultrox Process



① Hydrogen peroxide is combined with contaminated water.

② Ozone is generated and injected into the treatment tank.

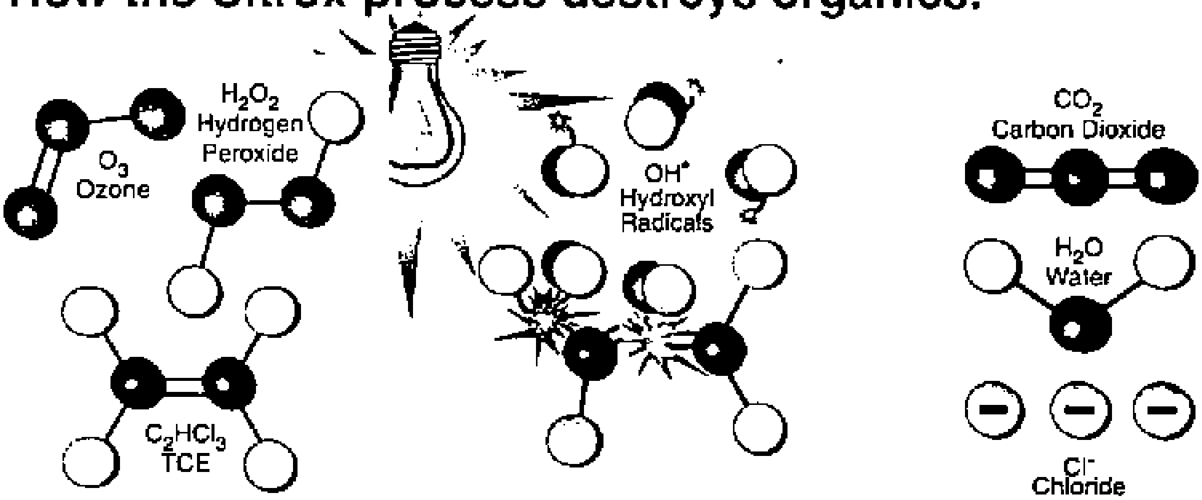
③ Contaminated water is pumped to the treatment tank and irradiated with ultraviolet light. The light reacts with the ozone gas and hydrogen peroxide, producing hydroxyl radicals which destroy organic contaminants. See example below.

④ Water flows from left to right through a series of treatment chambers.

⑤ Residual ozone in the offgas is converted to oxygen by a catalytic decomposer, eliminating any release of ozone.

⑥ Treated water flows to discharge.

How the Ultrox process destroys organics.



1. Hydrogen peroxide and ozone are added to water containing organics; this example shows trichloroethylene (TCE).

2. Ultraviolet light provides the energy to break up hydrogen peroxide and ozone into hydroxyl radicals. These radicals and the ultraviolet light attack the organic and break its chemical bonds.

3. Carbon dioxide and water are the end products, along with inorganic chlorides.

The Ultrox process uses ultraviolet light, ozone and hydrogen peroxide to destroy toxic organics.

Why move organics from one place to another?

To get rid of organics in water, you can remove them with carbon or strip them with air. But then they're left in a carbon bed or released into the atmosphere.

Ultrox has a better way—destroy the organics.

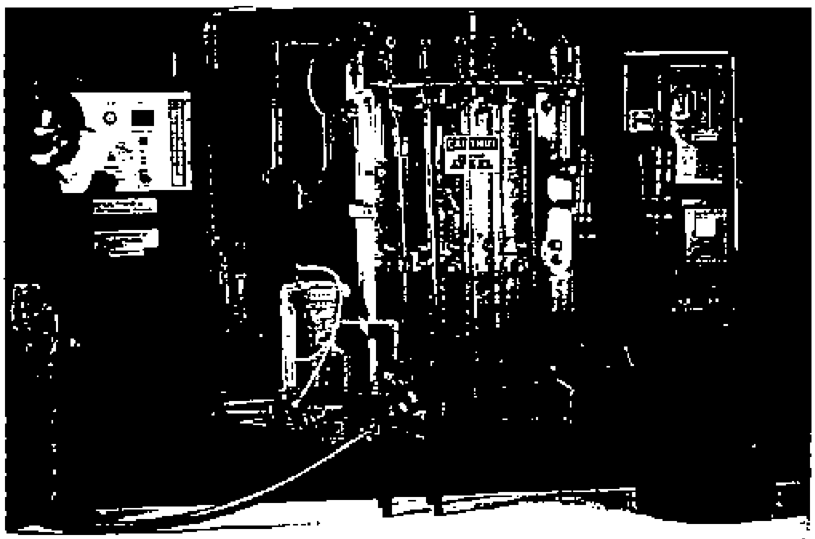
The Ultrox process uses ultraviolet light, ozone and hydrogen peroxide (UV/Oxidation) to break down toxic organics into harmless organic acids, carbon dioxide, water and trace salts. Results: no disposal costs and reduced liability.

Ultrox treats:
- groundwater
- drinking water
- process water
- industrial wastewater
- high purity cooling water
- leachate

Ultrox destroys:
- chlorinated solvents
- BTEX compounds
- PCBs
- semivolatile compounds
- pesticides
- phenols
- cyanides

The Ultrox advantage.

Commercially proven.
Ultrox has been in the UV/Oxidation business since 1984. Industries served include electric utility, aerospace, electronics, petroleum, wood treating and chemical processing as well as municipalities, DOD and DOE facilities. See the back page for selected case studies.



An Ultrox pilot plant may be installed on site to demonstrate the effectiveness of the UV/Oxidation process.

Low energy.
The patented combination of UV light with ozone and hydrogen peroxide allows Ultrox to use efficient, low intensity lamps.

Compact.
Ultrox systems are modular, compact and transportable for easy on-site installation.

Automatic.
Ultrox systems are automatic in a continuous flow or batch mode and require little monitoring.

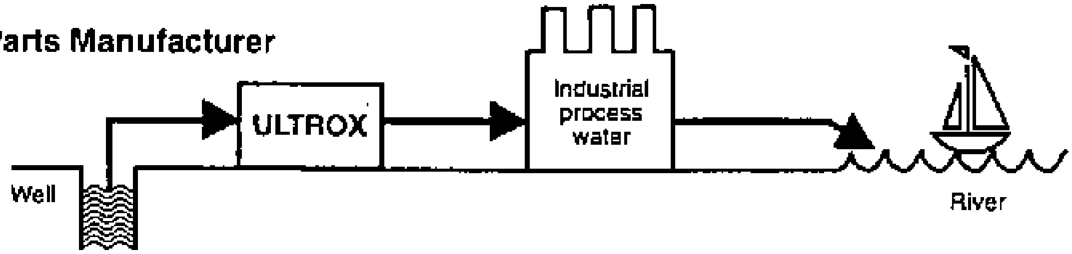
Low maintenance.
UV lamps last more than 9000 hours. The ozone generator dielectric cells require cleaning once every two years.

Compatible.
Ultrox systems can be integrated with carbon treatment, bioremediation and other technologies for enhanced cleanup.

Demonstrable.
Ultrox maintains a laboratory fully equipped to determine system performance on particular water streams. An Ultrox pilot plant can be installed on site to demonstrate effectiveness under actual operating conditions.

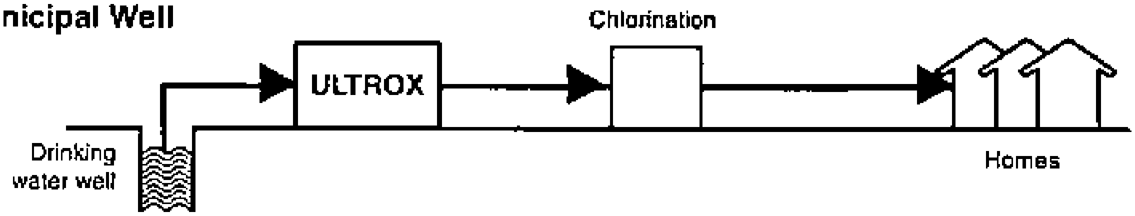
How industry is using the Ultrox process.

Auto Parts Manufacturer



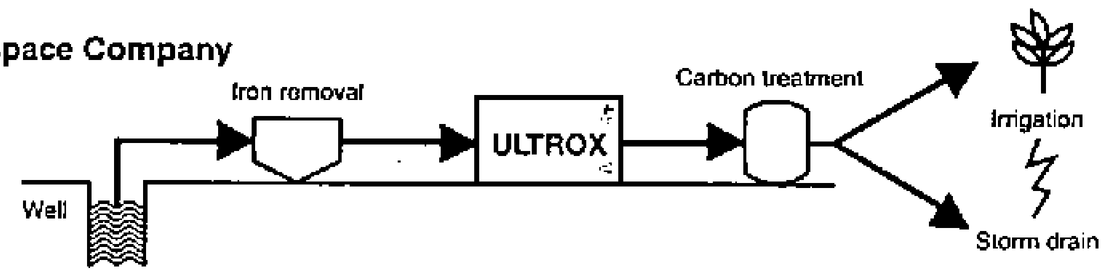
Input: 210 gpm of groundwater with 7000 ppb TCE, DCE, methylene chloride. Output: <4 ppb total VOCs.

Municipal Well



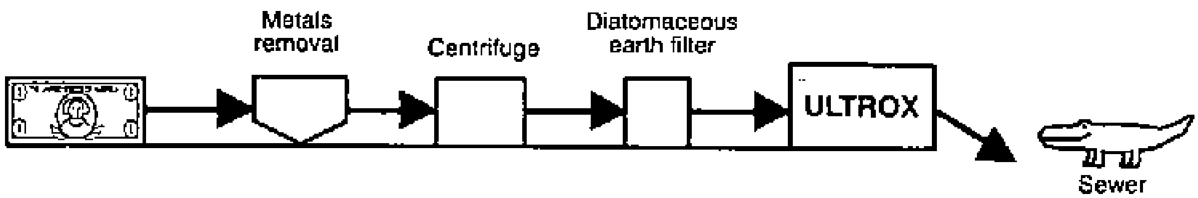
Input: 1150 gpm of groundwater with 20 ppb PCE. Output: <0.2 ppb PCE.

Aerospace Company



Input:100 gpm groundwater with 1500 ppb TCE, PCE, vinyl chloride, TCA, DCA. Output: drinking water standards.

U.S. Bureau of Engraving



Input: 50 gpm of wastewater from printing operation with 183 ppm cyanides. Output: < 2 ppm cyanides.

Give us a call.
For more information on the Ultrox process, call or fax with your water treatment needs.

A Halliburton Company

ULTROX

A Division of Resources Conservation Company

2435 South Anne Street
Santa Ana, CA 92704-5308
Phone: 714 545-5557
Fax: 714 557-5396

APPENDIX F - COST ESTIMATES

APPENDIX F - COST ESTIMATES

Project: Interim Remedial Measure for Ground Water
Defense Distribution Region Central, Memphis Tennessee

By: Engineering-Science, Inc. / St. Louis, MO
06/28/93

Cost Summary by Alternative

Alternative	Capital (1993 $)	Annual O & M (1993 $)	Net Present Value (10 yrs) 8.0%
2	$599,478	$270,187	$2,233,756
3	$604,293	$229,327	$1,984,349
4	$825,248	$303,487	$2,649,696
5	$471,078	$131,000	$1,250,092
6	$659,398	$163,500	$1,626,386
7	$498,213	$149,200	$1,388,294

APPENDIX F - COST ESTIMATES

ALTERNATIVE 2 COST ESTIMATE

06/28/93

On-Site Extraction, Air Stripping, POTW

Project: Interim Remedial Measure for Ground Water

Defense Distribution Region Central, Memphis Tennessee

Item No	Item	Quantity	Units	Unit Cost	Cost Extension
CAPITAL COSTS					
100	EXTRACTION WELLS				
101	Mobilization	1	LS	$4,000	$4,000
102	Well Drilling, 7 new wells	560	LF	$40	$22,400
103	Split Spoon Sampling	28	ea	$20	$560
104	6-inch ID St. Steel Casing	350	LF	$80	$28,000
105	6-inch ID St. Steel Screen	210	LF	$130	$27,300
106	Well Installation	560	LF	$15	$8,400
107	Well development	7	ea	$3,000	$21,000
110	Well Vault/Head completion	8	ea	$5,000	$40,000
111	Metering/B'flow prev	8	ea	$1,500	$12,000
112	Piping, Pump Discharge	600	LF	$6	$3,600
120	Elec Pump, 75 gpm	8	ea	$1,500	$12,000
121	Elec Controls	8	ea	$2,000	$16,000
122	Elec Power Distribution	2,000	LF	$15	$30,000
130	Piping, Collection Installed	2,000	LF	$10	$20,000
200	TREATMENT SYSTEM				
210	Site Prep/Concrete Pad	1	ea	$20,000	$20,000
220	Air Stripping Tower, 520 gpm	1	ea	$75,000	$75,000
230	Blower Fan, 1,000 scfm	1	ea	$9,000	$9,000
231	Elec Controls	1	ea	$20,000	$20,000
232	metering, Influent Piping	1	ea	$5,000	$5,000
300	ON-SITE PIPING FOR WATER DISPOSAL				
310	10-inch PVC sewer	300	LF	$20	$6,000
400	OFF-SITE SEWER UPGRADES				
410	15-Inch VCP sewer	3,000	LF	$54.00	$162,000
420	Manholes 1 per 500 LF	6	ea	$3,000	$18,000
	Estimated Design Cost	7.00% of Construction			$39,218
	Alternative 2 - Total Capital Costs				$599,478
OPERATION AND MAINTENANCE COSTS, ANNUAL					
900	Environmental Technician	500	hrs	$30.00	$15,000
911	Wells Eqt Repairs/replacement	8	well	$1,000	$8,000
912	Treat Eqt Repairs/replacement	1	ea	$12,000	$12,000
921	Electrical Costs	80,000	KWH	$0.08	$6,400
922	Sewer Use Charges	273,312	000 gal	$0.60	$163,987
930	Laboratory Analysis	56	samples	$300	$16,800
940	Reporting/Record Keeping	12	mo	$4,000	$48,000
	Alternative 2 - Total O & M Costs				$270,187

Net Present Value (1993 $) for 10 years 8.00% Interest $2,233,756

10 year cost per 1,000 gallons $0.817

APPENDIX F - COST ESTIMATES

ALTERNATIVE 3 COST ESTIMATE 06/28/93
On- & Off-Site Extraction, Air Stripping, POTW
Project: Interim Remedial Measure for Ground Water
Defense Distribution Region Central, Memphis Tennessee

Item No	Item	Quantity	Units	Unit Cost	Cost Extension
CAPITAL COSTS					
100	EXTRACTION WELLS				
101	Mobilization	1	LS	$4,000	$4,000
102	Well Drilling, 7 new wells	560	LF	$40	$22,400
103	Split Spoon Sampling	28	ea	$20	$560
104	6-inch ID St. Steel Casing	350	LF	$80	$28,000
105	6-inch ID St. Steel Screen	210	LF	$130	$27,300
106	Well Installation	560	LF	$15	$8,400
107	Well development	7	ea	$3,000	$21,000
110	Well Vault/Head completion	8	ea	$5,000	$40,000
111	Metering/B'flow prev	8	ea	$1,500	$12,000
112	Piping, Pump Discharge	600	LF	$6	$3,600
120	Elec Pump, 75 gpm	8	ea	$1,500	$12,000
121	Elec Controls	8	ea	$2,000	$16,000
122	Elec Power Distribution	3,000	LF	$15	$45,000
130	Piping, Collection Installed	3,000	LF	$10	$30,000
200	TREATMENT SYSTEM				
210	Site Prep/Concrete Pad	1	ea	$20,000	$20,000
220	Air Stripping Tower, 400 gpm	1	ea	$68,000	$68,000
230	Blower Fan, 800 scfm	1	ea	$7,500	$7,500
231	Elec Controls	1	ea	$20,000	$20,000
232	metering, Influent Piping	1	ea	$5,000	$5,000
300	ON-SITE PIPING FOR WATER DISPOSAL				
310	10-inch PVC sewer	300	LF	$20	$6,000
400	OFF-SITE SEWER UPGRADES				
410	15-Inch VCP sewer	3,000	LF	$50.00	$150,000
420	Manholes 1 per 500 LF	6	ea	$3,000	$18,000

	Estimated Design Cost	7.00% of Construction			$39,533
					=========
	Alternative 3 - Total Capital Costs				$604,293
OPERATION AND MAINTENANCE COSTS, ANNUAL					
900	Environmental Technician	500	hrs	$30.00	$15,000
911	Wells Eqt Repairs/replacement	8	well	$1,000	$8,000
912	Treat Eqt Repairs/replacement	1	ea	$12,000	$12,000
921	Electrical Costs	62,000	KWH	$0.08	$4,960
922	Sewer Use Charges	207,612	000 gal	$0.60	$124,567
930	Laboratory Analysis	56	samples	$300	$16,800
940	Reporting/Record Keeping	12	mo	$4,000	$48,000
					=========
	Alternative 3 - Total O & M Costs				$229,327

Net Present Value (1993 $) for 10 years 8.00% Interest $1,984,349
10 year cost per 1,000 gallons $0.956

APPENDIX F - COST ESTIMATES

ALTERNATIVE 4 COST ESTIMATE 06/28/93

On-Site Extraction, UV/Oxidation, POTW

Project: Interim Remedial Measure for Ground Water

Defense Distribution Region Central, Memphis Tennessee

Item No	Item	Quantity	Units	Unit Cost	Cost Extension
CAPITAL COSTS					
100	EXTRACTION WELLS				
101	Mobilization	1	LS	$4,000	$4,000
102	Well Drilling, 7 new wells	560	LF	$40	$22,400
103	Split Spoon Sampling	28	ea	$20	$560
104	6-inch ID St. Steel Casing	350	LF	$80	$28,000
105	6-inch ID St. Steel Screen	210	LF	$130	$27,300
106	Well Installation	560	LF	$15	$8,400
107	Well development	7	ea	$3,000	$21,000
110	Well Vault/Head completion	8	ea	$5,000	$40,000
111	Metering/B'flow prev	8	ea	$1,500	$12,000
112	Piping, Pump Discharge	600	LF	$6	$3,600
120	Elec Pump, 75 gpm	8	ea	$1,500	$12,000
121	Elec Controls	8	ea	$2,000	$16,000
122	Elec Power Distribution	2,000	LF	$15	$30,000
130	Piping, Collection Installed	2,000	LF	$10	$20,000
200	TREATMENT SYSTEM				
210	Site Prep/Building	1	ea	$50,000	$50,000
220	UV Oxidation unit, 520 gpm	1	ea	$200,000	$200,000
230	Chemical Storage/Handling	1	ea	$20,000	$20,000
231	Elec Controls	1	ea	$30,000	$30,000
232	Metering, Influent Piping	1	ea	$5,000	$5,000
240	Effluent Sump	1	ea	$25,000	$25,000
241	Effluent Pump/Piping	1	ea	$10,000	$10,000
300	ON-SITE PIPING FOR WATER DISPOSAL				
310	10-inch PVC sewer	300	LF	$20	$6,000
400	OFF-SITE SEWER UPGRADES				
410	15-Inch VCP sewer	3,000	LF	$54.00	$162,000
420	Manholes 1 per 500 LF	6	ea	$3,000	$18,000
	Estimated Design Cos	7.00%of Construction			$53,988
	Alternative 4 - Total Capital Costs				$825,248
OPERATION AND MAINTENANCE COSTS, ANNUAL					
900	Environmental Technician	500	hrs	$30.00	$15,000
901	UV Sys Engr	200	hrs	$60.00	$12,000
911	Wells Eqt Repairs/replacement	8	well	$1,000	$8,000
912	Treat Eqt Repairs/replacement	1	ea	$12,000	$12,000
921	Electrical Costs	200,000	KWH	$0.08	$16,000
922	Sewer Use Charges	273,312	000 gal	$0.60	$163,987
923	Hydrogen Peroxide	26,000	lbs/yr	$0.45	$11,700
930	Laboratory Analysis	56	samples	$300	$16,800
940	Reporting/Record Keeping	12	mo	$4,000	$48,000
	Alternative 4 - Total O & M Costs				$303,487
	Net Present Value (1993 $) for 10 years	8.00% Interest			$2,649,696
	10 year cost per 1,000 gallons				$0.969

APPENDIX F - COST ESTIMATES

ALTERNATIVE 5 COST ESTIMATE

06/28/93

On-Site Extraction, Air Stripping, Surface Drainage
Project: Interim Remedial Measure for Ground Water
Defense Distribution Region Central, Memphis Tennessee

Item No	Item	Quantity	Units	Unit Cost	Cost Extension
CAPITAL COSTS					
100	EXTRACTION WELLS				
101	Mobilization	1	LS	$4,000	$4,000
102	Well Drilling, 7 new wells	560	LF	$40	$22,400
103	Split Spoon Sampling	28	ea	$20	$560
104	6-inch ID St. Steel Casing	350	LF	$80	$28,000
105	6-inch ID St. Steel Screen	210	LF	$130	$27,300
106	Well Installation	560	LF	$15	$8,400
107	Well development	7	ea	$3,000	$21,000
110	Well Vault/Head completion	8	ea	$5,000	$40,000
111	Metering/B'flow prev	8	ea	$1,500	$12,000
112	Piping, Pump Discharge	600	LF	$6	$3,600
120	Elec Pump, 75 gpm	8	ea	$1,500	$12,000
121	Elec Controls	8	ea	$2,000	$16,000
122	Elec Power Distribution	2,000	LF	$15	$30,000
130	Piping, Collection Installed	2,000	LF	$10	$20,000
200	TREATMENT SYSTEM				
210	Site Prep/Concrete Pad	1	ea	$20,000	$20,000
220	Air Stripping Tower, 520 gpm	1	ea	$75,000	$75,000
230	Blower Fan, 1,000 scfm	1	ea	$9,000	$9,000
231	Elec Controls	1	ea	$20,000	$20,000
232	Metering, Influent Piping	1	ea	$5,000	$5,000
240	Effluent Sump	1	ea	$25,000	$25,000
241	Effluent Pump/Piping	1	ea	$10,000	$10,000
300	ON-SITE PIPING FOR WATER DISPOSAL				
310	10-inch Force Main	1,000	LF	$25	$25,000
320	Discharge Headwall	1	ea	$6,000.00	$6,000
	Estimated Design Cost	7.00% of Construction			$30,818
	Alternative 5 - Total Capital Costs				$471,078
OPERATION AND MAINTENANCE COSTS, ANNUAL					
900	Environmental Technician	500	hrs	$30.00	$15,000
911	Wells Eqt Repairs/replacement	8	well	$1,000	$8,000
912	Treat Eqt Repairs/replacement	1	ea	$12,000	$12,000
921	Electrical Costs	90,000	KWH	$0.08	$7,200
930	Laboratory Analysis	136	samples	$300	$40,800
940	Reporting/Record Keeping	12	mo	$4,000	$48,000
	Alternative 5 - Total O & M Costs				$131,000

Net Present Value (1993 $) for 10 years 8.00% Interest $1,250,092
10 year cost per 1,000 gallons $0.457

ALTERNATIVE 6 COST ESTIMATE 06/28/93

On-Site Extraction, UV/Oxidation, Surface Drainage

Project: Interim Remedial Measure for Ground Water

Defense Distribution Region Central, Memphis Tennessee

Item No	Item	Quantity	Units	Unit Cost	Cost Extension
CAPITAL COSTS					
100	EXTRACTION WELLS				
101	Mobilization	1	LS	$4,000	$4,000
102	Well Drilling, 7 new wells	560	LF	$40	$22,400
103	Split Spoon Sampling	28	ea	$20	$560
104	6-inch ID St. Steel Casing	350	LF	$80	$28,000
105	6-inch ID St. Steel Screen	210	LF	$130	$27,300
106	Well Installation	560	LF	$15	$8,400
107	Well development	7	ea	$3,000	$21,000
110	Well Vault/Head completion	8	ea	$5,000	$40,000
111	Metering/B'flow prev	8	ea	$1,500	$12,000
112	Piping, Pump Discharge	600	LF	$6	$3,600
120	Elec Pump, 75 gpm	8	ea	$1,500	$12,000
121	Elec Controls	8	ea	$2,000	$16,000
122	Elec Power Distribution	2,000	LF	$15	$30,000
130	Piping, Collection Installed	2,000	LF	$10	$20,000
200	TREATMENT SYSTEM				
210	Site Prep/Building	1	ea	$50,000	$50,000
220	UV Oxidation unit, 520 gpm	1	ea	$200,000	$200,000
230	Chemical Storage/Handling	1	ea	$20,000	$20,000
231	Elec Controls	1	ea	$30,000	$30,000
232	Metering, Influent Piping	1	ea	$5,000	$5,000
240	Effluent Sump	1	ea	$25,000	$25,000
241	Effluent Pump/Piping	1	ea	$10,000	$10,000
300	ON-SITE PIPING FOR WATER DISPOSAL				
310	10-inch Force Main	1,000	LF	$25	$25,000
320	Discharge Headwall	1	ea	$6,000.00	$6,000
	Estimated Design Cost	7.00% of Construction			$43,138
	Alternative 6 - Total Capital Costs				$659,398
OPERATION AND MAINTENANCE COSTS, ANNUAL					
900	Environmental Technician	500	hrs	$30.00	$15,000
901	UV Sys Engr	200	hrs	$60.00	$12,000
911	Wells Eqt Repairs/replacement	8	well	$1,000	$8,000
912	Treat Eqt Repairs/replacement	1	ea	$12,000	$12,000
921	Electrical Costs	200,000	KWH	$0.08	$16,000
923	Hydrogen Peroxide	26,000	lbs/yr	$0.45	$11,700
930	Laboratory Analysis	136	samples	$300	$40,800
940	Reporting/Record Keeping	12	mo	$4,000	$48,000
	Alternative 6 - Total O & M Costs				$163,500

Net Present Value (1993 $) for 10 years 8.00% Interest $1,626,386

10 year cost per 1,000 gallons $0.595

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE

FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE