RESPONSES TO COMMENTS ON
DRAFT REMEDIAL INVESTIGATION REPORT
FOR FORMER HAZARDOUS WASTE DISPOSAL AREA
AT HASSAYAMPA LANDFILL
MARICOPA COUNTY, ARIZONA

ERROL L. MONTGOMERY & ASSOCIATES, INC.
CONSULTANTS IN HYDROGEOLOGY
1075 EAST FORT LOWELL ROAD, SUITE B
TUCSON, ARIZONA 85719 (602) 881-4912
TELEX: 16597 MONTE TUC

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
382 WEST COUNTY ROAD D
ST. PAUL, MINNESOTA 55112
TELEPHONE (612) 639-0913
February 7, 1991

Thomas J. Dunkelman (H-7-2)
Remedial Project Manager
U. S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorne Street
San Francisco, California 94105

RE: RESPONSES TO COMMENTS ON DRAFT REMEDIAL INVESTIGATION REPORT AND LIQUID WASTE EVALUATION FOR HASSAYAMPA PROJECT

Dear Mr. Dunkelman:

On November 28, 1990, we received comments via telefax from the U. S. Environmental Protection Agency (EPA), Arizona Department of Environmental Quality (ADEQ), and Arizona Depater Resources (ADWR) on the draft Remedial Investigation (RI) Report, dated October 11, 1990, and the draft Liquid Waste Evaluation, dated October 9, 1990, for the hazardous waste area (the Site) at the Hassayampa Landfill (the Landfill), Maricopa County, Arizona. The regulatory agency comments and our final responses to the comments are attached hereto.

Draft written responses to comments were submitted to EPA, ADEQ, and ADWR on December 21, 1990. A conference call to discuss EPA and ADEQ comments on the draft responses was held on January 8, 1991. During our discussion, you requested that the final responses be accompanied by a list of locations in the final RI Report and the final Liquid Waste Evaluation where appropriate comments are addressed. The final responses and the requested lists are given in the following attachments:

ATTACHMENT 1: EPA comments and responses
ATTACHMENT 2: ADEQ comments and responses
ATTACHMENT 3: ADWR comments and responses
ATTACHMENT 4: LIST OF SUBSTANTIVE REVISIONS TO DRAFT RI REPORT WITH REFERENCES TO COMMENTS BY EPA
ATTACHMENT 5: LIST OF SUBSTANTIVE REVISIONS TO DRAFT LIQUID WASTE EVALUATION REPORT WITH REFERENCES TO COMMENTS BY EPA
In accordance with the distribution list for the Consent Order, two additional copies of this letter with attachments are enclosed herewith.

If you have questions or require further discussion, please contact me.

Very truly yours,
ERROL L. MONTGOMERY & ASSOCIATES, INC.

William R. Victor

William R. Victor

SENT VIA FEDERAL EXPRESS

Attachments

February 7, 1991

RESPONSES TO COMMENTS ON
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FOR FORMER HAZARDOUS WASTE DISPOSAL AREA
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ATTACHMENT 1

RESPONSES TO COMMENTS BY
U. S. ENVIRONMENTAL PROTECTION AGENCY

The following responses are to U. S. Environmental Protection Agency (EPA) comments, dated November 26, 1990, on the draft Remedial Investigation (RI) Report, dated October 11, 1990, and the Liquid Waste Evaluation, dated October 9, 1990, for the hazardous waste area (the Site) at the Hassayampa Landfill (the landfill), Maricopa County, Arizona. EPA comments are referenced by the sequential number of the comment and/or the page on which it is given in the EPA document. Responses were prepared by Errol L. Montgomery & Associates, Inc. (M&A) and by Conestoga-Rovers & Associates (CRA).

GENERAL COMMENT 1, PAGE 1: The RI report does a good job of presenting the results of the investigations conducted; however, the level of interpretation and analysis needs to be expanded. Several examples of this are given in the Specific Comments section. In particular, interpretive analyses of the nature and extent of contamination and fate and transport of contaminants are lacking in detail. The inclusion of such information in an RI report is discussed in Sections 3.4.1.3 and 3.4.1.4 of the EPA manual "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (October 1988). The RI should include a separate section, near the end of the report, which interprets the results presented, particularly with respect to fate and transport of contaminants. Those Specific Comments which pertain to issues which should be discussed in this section are designated by the symbol "FT".

RESPONSE: The interpretations and analysis given in the RI Report are appropriate and concise for the scope of the RI. A major purpose of the RI is to provide the essential data required for proper conduct of the Feasibility Study (FS). Several of the EPA comments include recommendations for additional interpretations and analyses that are non-essential.
to the scope of the RI or are purely academic in value. In some cases, expanded interpretations recommended in the comments could result in unnecessary speculation and misleading conclusions. Residual uncertainty is inherent in all remedial investigations; the level of uncertainty remaining from the Hassayampa RI is considered to be acceptable because the data developed and presented is more than sufficient to allow for the selection of an appropriate remedial action.

The RI Report was prepared in accordance with Section VII.B.5 of the Administrative Consent Order, dated February 19, 1988, and the detailed Work Plan attached to the Administrative Consent Order as Exhibit A, in which EPA specified in detail the information required for the report. The Consent Order does not require that a separate section on "fate and transport of contaminants" be included in the report. Interpretation of results is given in each section of the report and is discussed further in summary sections, including the "Summary of Results and Conclusions" section that begins on page 1 of the report. Notwithstanding these facts, M&A and CRA will prepare a separate section on "Contaminant Transport and Fate" for the final RI Report to accommodate this new request by EPA.

GENERAL COMMENT 2, PAGE 1: EPA has several concerns regarding data coverage for the site. The Agency is not anxious to request additional field work which will lead to an increase in the cost or duration of the RI/FS. Nonetheless, EPA feels that there are a few pieces of critical information which are lacking from the RI report. Without this information, EPA believes that it would be difficult to assess various remedial alternatives for the site. Those Specific Comments which pertain to potential additional data requirements are designated by the symbol "DR". Generally, the potential additional data requirements perceived by EPA are as follows:

- Installation of additional angle borings beneath Pits 1 and 3 in order to better define soil contamination with depth. This information could be used to better estimate the
volume of waste in the pits, and determine whether deep soil contamination is acting as a continuing source of groundwater contamination.

- Installation of a monitoring well in Unit B, in the vicinity of MW-6UA.
- Soil gas survey to determine if unidentified contaminant sources exist in the Special Pits Area.

RESPONSE: The following responses address the "potential additional data requirements" described in this comment:

- **Additional Angle Borings at Pits 1 and 3:** The number of soil borings was specified in the Supplemental Work Plan, which was designed and negotiated with EPA with the intention of providing the remainder of the data required for the RI. As described in the Work Plans, the RI was designed to evaluate the entire Site as a potential source of contamination. The consultant team believed that sufficient soil data had been obtained during Stage I; however, at the request of EPA, additional soil borings were drilled and sampled during Stage II at individual disposal pits; this additional data has not changed our position.

Regarding this specific EPA comment, it is difficult to understand how any additional angle borings could provide essential data for estimation of volume of waste in the pits. Volumes of waste disposed are more appropriately estimated using the manifests issued by Arizona Department of Health Services (ADHS). Many soil borings have been drilled and sampled at the Site; the soils encountered were not saturated or near saturation, and results for deep soil samples did not indicate deep "pooling" of liquids in the vadose zone. CRA indicates that additional angle borings are not necessary for proper conduct of the FS; additional data for final design of a potential vadose zone remedial action may be necessary, but not during the RI or FS.

In a telephone discussion on January 8, 1991, regarding this EPA comment, EPA indicated that additional soil borings would not be required to complete the RI/FS.

- **Additional Unit B Monitor Well at the MW-6UA Site:** The Supplemental Work Plan was designed and negotiated with EPA to provide the data necessary for completion of the RI; an additional Unit B monitor well was not included in the Supplemental Work Plan. Three Unit B monitor wells are located in the direction of groundwater movement from the MW-6UA site. Volatile organic compounds have not been detected and confirmed in groundwater samples obtained from these Unit B monitor wells. CRA indicates that the additional Unit
B monitor well is not necessary for proper conduct of the FS or for proper design of a potential groundwater remedial action.

The RI was designed to consider the entire Site as a potential source of groundwater contamination; wells to monitor Unit A and Unit B were constructed along the downgradient perimeter of the Site, and in the central part of this Site downgradient and nearer to Pits 1 and 3, where the largest volume of liquid waste containing solvents was disposed. The existing array of downgradient Unit B monitor wells are sufficient for monitoring potential future movement of contaminants into Unit B at the Site.

Montgomery & Associates and CRA consider construction of the requested Unit B monitor well unnecessary for completion of the RI or the FS. We have offered to EPA that, if at some point an interim remedial action is considered, it may be desirable to evaluate the need for an additional Unit B monitor well. In spite of the clear intent of the EPA-approved RI/FS Work Plans and the lack of contaminant detection in existing Unit B monitor wells, EPA has responded that, unless the requested well is constructed prior to submittal of the FS Report, the Record of Decision would require remediation of Unit B and approval of the FS Report would be jeopardized.

The Hassayampa Steering Committee has been advised of EPA's insistence on the additional Unit B well and concurs that such a well is unnecessary for the RI/FS. However, in order to avoid a dispute with EPA on this issue now, which would delay the RI/FS from proceeding as scheduled, the Hassayampa Steering Committee has agreed to authorize construction of the requested well.

In the EPA letter to CRA dated January 15, 1991, EPA agreed that the additional Unit B monitor well is not required for approval of the RI Report, with the understanding that this additional work will be conducted as part of the FS.

At EPA's request, a discussion of this additional Unit B monitor well will be included in the section of the RI Report titled "Feasibility Study Testing Proposal". A proposed scope of work for this well was given in a letter dated January 25, 1991, to EPA.

**Soil Gas Survey:** CRA and Montgomery & Associates consider the implementation of a soil gas survey in the Special Pit areas (assumed to be referring to the area around soil boring SB-16) unnecessary to complete the RI or the FS. A soil gas survey may provide an indication of contaminant sources within the Special Pit areas, but it may also reflect the presence of soil vapors from other disposal pits in the hazardous waste area or from the nearby sanitary landfill. CRA indicates that a soil gas survey may be a useful tool in the design of some remedial alternatives, such as soil vapor extraction, but the data from such a survey would not be necessary to select a Site remedy in the FS.
The waste manifest database given in Appendix B of the Liquid Waste Evaluation (CRA and M\&A, October 9, 1990) tracks the intended location of the bulk of the hazardous waste disposal that was approved by ADHS and that occurred at the Site. The Special Pits were reported by landfill personnel and the Bureau of Waste Control as being diffuse, small, low-volume disposal cells spread out over several areas of the Site.

It must be noted that the RI field program was conducted on the basis that the Site was a single disposal unit and that the nature of contamination (soil and groundwater sampling) was required to be defined for the entire Site, not each disposal pit. Precise delineation of soil contamination within each discrete disposal pit was not envisioned as being required in the RI, was not required in the RI/FS Work Plans, and is not required for completion of a FS (see "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, pages 1-3, EPA October 1988").

The Hassayampa Steering Committee strongly concurs that a soil gas survey is unnecessary. However, in order to avoid a dispute with EPA on this issue now, which would delay the RI/FS from proceeding as scheduled, the Hassayampa Steering Committee has agreed to authorize conduct of the requested soil gas survey with the following condition. The Hassayampa Steering Committee has proposed to conduct the soil gas survey on the understanding that the data obtained would be used in the FS and that no further field work, such as soil borings and soil chemical analyses, would be contemplated by EPA prior to finalization of the FS and initiation of Remedial Design/Remedial Action. It is anticipated that the soil gas survey will be conducted concurrently with construction of the additional Unit B monitor well.

In the EPA letter to CRA dated January 15, 1991, EPA agreed that the soil gas survey is not required for approval of the RI Report, with the understanding that this additional work will be conducted as part of the FS.

At EPA’s request, a discussion of the soil gas survey will be included in the section of the RI Report titled "Feasibility Study Testing Proposal". A proposed scope of work for the soil gas survey was given in a letter from M\&A to EPA dated January 25, 1991.

**GENERAL COMMENT 3, PAGES 1 AND 2:** The RI report should include a section entitled Data Limitations and Data gaps which assesses the implications of any such limitations and gaps. Those Specific Comments which pertain to data limitations are desig-
noted by the symbol "DL". Furthermore, any issues identified by General Comment 2 which are not resolved by further sampling should be discussed in this section.

**RESPONSE:** Data Limitations and Data Gaps are addressed and discussed in the appropriate Sections of the RI Report, and a separate report section for Data Limitations and Data Gaps was not specified by EPA in the detailed report requirements given in the Consent Order. These limitations should be identified during the preparation of the FS report in order to develop cost estimates and sensitivity analyses to be refined during the remedial design phase of the project. In a telephone discussion on January 8, 1991, regarding this EPA comment, EPA indicated that a separate section on data limitations would not be required for the RI Report.

**SPECIFIC COMMENT 1, PAGE 2:** p. 34 - 35. Although it is mentioned on p. 22, the Waste Types and Quantities section should reference the types of wastes placed in Pits A and B. Furthermore, this section should include a more detailed description of the types and quantities of waste placed in the Special Pits Area. According to p. 5 of the LWE, a summary of the types and quantities of wastes disposed in the Special Pits is tabulated by the Bureau of Waste Control (1980).

**RESPONSE:** Pits A and B were not part of the manifest program and were not designated for disposal of the hazardous wastes identified as having been generated by the Respondents. The "Waste Types and Quantities" section was written specifically for hazardous waste designated for disposal at the Site. However, an additional description for Pits A and B similar to the description given on page 22 of the draft RI Report will be added to the "Waste Types and Quantities Section", together with a reference to the manifest program.

Regarding detail for the types and quantities of wastes designated for disposal in the Special Pits, the reader is directed on page 21 of
the report to Appendix B of the report, which contains the Bureau of Waste Control (1980) inventory; Appendix B is also cited on page 34 in the discussion of Special Pits. The types of waste disposed in the Special Pits are discussed at the end of the first paragraph on page 35 of the draft report. However, this discussion will be expanded and a sentence will be added to page 35 to specifically direct the reader to Appendix B.

**SPECIFIC COMMENT 2, PAGE 2: FT p. 44.** The RI report needs to expand upon its investigation and discussion of upper alluvial deposits as interpreted from the wall of the large excavation located within the landfill. This excavation provides a valuable source of information which has not been adequately presented in the RI. This should include a detailed geologic description of coarse and fine-grained sub-units, a description of sedimentary structures present, and a description of any other features that might influence the hydrogeologic properties of this unit. In the opinion of EPA personnel and contractors, the observed lithology of the cut surface suggests that liquid wastes disposed onsite could have easily migrated vertically through this unit. The presence of lateral-vertical lenses of sand and gravel and thin, caliche-filled fractures would contribute to the ability of wastes to migrate through this unit. The reaction of acids from the pits with carbonate cement present in the upper alluvial deposits would could also increase permeability beneath the pits. If such models are accurate, it is possible that evaporation from the disposal pits may have been overestimated, and downward migration of contaminants may have been underestimated.

**RESPONSE:** The active sanitary landfill cell located south from the hazardous waste area was excavated late in the RI. After the coarse-grained part of the upper alluvial deposits unit was exposed in the north wall of the excavation, Montgomery & Associates personnel inspected the exposure. Many detailed descriptions of the coarse-grained part of the upper alluvial deposits unit are given in the RI Report, and results of the inspection of the north wall of the excava-
tion did not conflict with these descriptions. Sedimentary structures were the principal features found during the inspection that are not available from soil borings and monitor wells; these features were discussed on page 47 of the draft RI Report. A measured stratigraphic section for the sediments exposed in the excavation will be added as an illustration to the report and will be mentioned on page 47 of the draft RI Report.

It is not clear what is meant by "lateral-vertical" lenses of sand and gravel. Alluvial deposits typically contain discontinuous, nearly horizontal, lenses of coarse-grained and fine-grained sediments; however, "vertical lenses" are unusual and were not observed in outcrops. Liquids may migrate for short distances in discontinuous lenses of coarse-grained sediments; however, the lenses of fine-grained sediments may impede migration of the liquids and may be a controlling factor for rate of downward percolation of liquids.

Based on our inspection, the coarse-grained part of the upper alluvial deposits unit exposed in the excavation is generally unconsolidated and would not support "fractures", except where caliche is dominant. However, "caliche-filled fractures" discussed in this comment would not be expected to enhance downward migration of liquids. The buffering capacity of sediments in the upper alluvial deposits unit must be emphasized; it is untenable to assume that acids disposed at the hazardous waste area could increase the permeability of soils more than a few feet beneath the pits. It is unclear to what "models" this comment refers.

Discussions of hydrogeologic characteristics of the lithologic units given in the "Site Hydrogeologic Features Section" of the draft report will expanded for the final report. The proposed "Fate and Transport of Contaminants" section of the final report will include a discussion of the effects of hydrogeologic conditions on the transport of contaminants.
SPECIFIC COMMENT 3, PAGE 2: FT p. 48. The discussion of the basaltic lava-flow unit should include a description of those locations where this formation was observed to outcrop. This should include a description of the nature of the outcrop, fractures, voids, or any other features of the basalt that could have a bearing on its hydrogeologic properties.

**RESPONSE:** Basaltic lava-flow rocks crop out on Arlington Mesa, which is believed to be the source for the basaltic lava-flow unit described in the draft RI Report. Outcrops on Arlington Mesa were inspected in a cursory manner by Montgomery & Associates personnel. The rocks cropping out on Arlington Mesa may be derived from a different phase of eruption than the basaltic lava-flow rocks encountered in the subsurface in soil borings and monitor wells at the landfill, and may not be representative for rocks at the landfill. However, the discussion of the basaltic lava-flow unit given on page 48 of the draft RI Report will be expanded to summarize in more detail the character of the unit based on data obtained from soil borings and monitor wells.

SPECIFIC COMMENT 4, PAGE 2: FT p. 50. The structural contour analysis presented here is very interesting and should be expanded upon. If sufficient data exists, structural contour maps should be prepared for the top of Units A and B. Also, a structure-contour map depicting the thickness of the basalt unit would be helpful. To the extent possible, the structure contour analyses should be used to discuss fate and transport of contaminants.

**RESPONSE:** The top of the fine-grained part of the upper alluvial deposits unit and the top of the basaltic lava-flow unit were selected for construction of structural contour maps because these two horizons would be the most likely horizons to have influenced lateral movement of liquids in the vadose zone. Deeper horizons, such as the tops of Unit A and Unit B are in the saturated zone, where the principal control on movement of liquid is the groundwater hydraulic gradient. Structural contour maps for the tops of Units A and B are not pertinent for the RI
and would chiefly be of academic value only. However, the data necessary for such maps is given in Table 7 of the draft report.

Thickness of the basaltic lava-flow unit is given on pages 48 and 49 and in Table 7; construction of an isopach map for this unit was considered unnecessary for the RI Report and was not included. However, at the request of EPA, the text on page 49 will be expanded with regard to thickness and slope of the unit.

Content of the "Structural Contours" section on page 50 of the draft RI Report is sufficient for the purposes of the RI. The proposed "Fate and Transport of Contaminants" section of the report will include a discussion of the structural contours for the top of the fine-grained part of the upper alluvial deposits unit and the top of the basaltic lava-flow unit.

**SPECIFIC COMMENT 5. PAGES 2 AND 3**: Fig. 3 and Fig. G-1. Pit dimensions illustrated in these two figures do not match very well, particularly for Pits 1, 2, and 3.a. These figures should be revised so that the pits dimensions are the same or similar in both figures.

**RESPONSE**: As indicated in the explanation on Figure G-1 of Appendix G, this figure shows a schematic diagram on which "locations and dimensions of pits and trenches are not to scale". The purpose of Figure G-1 is to show schematically the relative orientation of the pits and the trenches and the location of sampling sites for trace gas analysis. As indicated in the explanation on Figure 3, Figure 3 shows the approximate boundaries of the pits and the locations where samples of waste were obtained from certain pits. Neither figure requires revision.

**SPECIFIC COMMENT 6. PAGE 3**: p. 59. The depth of trenches ranged from 4-12 ft. below land surface, but generally did not penetrate more than 1 ft. into top of buried waste.
If the soil cover across the site is 1-2 ft. thick, how can this statement be correct? This issue comes up several times throughout the report, and requires some clarification.

**RESPONSE:** Landfill personnel reported that the pits were allowed to dry out to prevent overflow of liquid wastes when the pits were filled with soil. Therefore, the soil cover is thickest in the pits and is thinner in areas outside the pits. These conditions will be discussed in more detail on pages 59 and 76 of the draft RI Report. The exploration trenches were excavated to penetrate the top of the waste in each pit to delineate the pit edges and to inspect the contents; the intent was not to dig further into the waste.

**SPECIFIC COMMENT 7, PAGE 3:** DL p. 59. At most there is only one waste sample point per pit. Some pits have no such sampling points (i.e., Pit 3b, Pit 4a, Pit A, Pit B, and Special Pits). Provide rationale describing how the waste sample locations were selected. Also include a discussion of the likelihood that the waste sample is representative of the waste contained in the pit.

**RESPONSE:** Collection and analysis of samples of waste from the pits were not required by the Work Plan or the Supplemental Work Plan, which were approved by EPA. Samples were obtained to characterize the waste to which field personnel could potentially be exposed. The samples were selected on a visual basis to be generally representative for the types of waste exposed in trenches at each pit. The waste exposed in Pit 3c was visually similar to waste exposed in Pit 3b, and Pits 3b and 3c were connected via overflow ditches whereby mixing of wastes between the two pits is understood to have occurred. Therefore, the waste sample obtained from Pit 3c was considered generally representative for the waste exposed in Pit 3b and it was not necessary to sample the waste exposed in Pit 3b. The samples of waste were not intended to be necessarily representative for all of the waste disposed in each pit sampled. Trenches were not excavated in Pit 4a, Pit A, and Pit B;
therefore, samples of waste were not obtained from these pits. Pits A and B were not part of the manifest program and were not designated for disposal of the hazardous wastes identified as having been generated by the Respondents. A discussion of the sampling procedures and representativeness for the samples of waste will be added to page 59 of the draft report.

**SPECIFIC COMMENT 8, PAGE 3: DL p. 66-69.** The comparison of waste data to angle boring data and the statements regarding lack of downward migration of contaminants may not be as significant as presented here. This is particularly true for Pit 1 and Pit 3c, where significant horizontal distances (up to 50 ft) separate the waste sample locations and angle boring locations. The RI assumes that the waste sample is representative of waste in the pit, but there has been no discussion of this. The RI should discuss this issue and whether it is appropriate to make such data comparisons.

**RESPONSE:** As stated in the response to Specific Comment 7, the purpose of obtaining samples of the waste was not to fully characterize all of the waste in each pit, but to obtain a generally representative sample of the exposed waste based on visual inspection. In general, the waste exposed in a specific pit was consistent in appearance. Therefore, within the limits of the waste sampling criteria, the samples were generally representative of the waste exposed in the trenches. We believe the comparisons made on pages 66 through 74 of the report are appropriate; however, a discussion of representativeness will be added to page 66 as a preface to these comparisons.

**SPECIFIC COMMENT 9, PAGES 3 AND 4: FT, DR, DL p. 66-73.** EPA is concerned about the data coverage for soil and waste samples. As mentioned in previous comments the waste sample coverage is poor. This is also true for soil samples. Several significant data gaps exist with respect to soil and waste characterization.
a. The vertical extent of waste within the pits and shallow soils is poorly defined, and as a result it would be difficult to estimate the volume of material potentially requiring excavation or treatment.

b. It is possible that contamination within the Special Pits Area could have gone undetected, especially since groundwater contamination at MW-IUA has not been adequately accounted for. A soil gas survey could be employed to detect any such sources of contamination.

c. The contaminant profile beneath Pits 1 and 3 is poorly understood due to the limited number of soil borings. The highest level of soil contamination was detected in the deepest sample (AB-3 - 60 ft). Additional soil borings should be installed in order to better understand how the contaminant profile changes with depth, and to determine whether soil contamination extends into the basalt unit and Units A and B. Furthermore, these issues need to be addressed in the Fate and contaminant section. Questions such as the following need to be answered:

- Are contaminants "pooling" on top of the basalt?
- Is it possible that paleo-relief along the basalt unit is influencing the patterns of soil and groundwater contamination?
- Does the soil contaminant profile extend through the basalt into the underlying units?
- Is soil contamination at depth acting as a continuing source of groundwater contamination?

**RESPONSE:** Regarding comments on waste samples, please refer to the responses to Specific Comments 7 and 8. Soil sampling requirements were approved by EPA in the Work Plan and Supplemental Work Plan, and data from the soil investigations is sufficient for the stated purposes of the RI. Where appropriate, the issues discussed in these comments will be addressed in the "Contaminant Transport and Fate" section of the final report.

9A/9B In the case of Pit 1, the waste referred to by EPA is accumulated sludges and debris at the bottom of each pit. As discussed in the response to EPA General Comment 2, Collection and Analysis of waste samples was beyond the scope of the RI Work Plan. Further delineation of the thickness of this waste zone is not required in order to complete the FS.
Remedies evaluated in the FS will be based on a common set of assumptions concerning the mass of contamination existing in the Pits and in the underlying materials. All alternatives would be impacted proportionately by the level of imprecision in the data, so the selection of the remedy would not be affected.

Further delineations of the contaminant profile with depth would not give rise to substantial beneficial data. The soil samples collected from AB-3 at a drilling depth of 60 feet did contain the highest reported numeric values of contamination, but these values are essentially the same magnitude as the other samples collected from beneath Pit 1. Given the heterogeneity of soil, the expected variability in data from the analyses of soil, and the fact that shallow soil samples from the angle borings were not from beneath the pits, it should be concluded that the contamination measured under Pit 1 was essentially constant with depth. However, EPA notes that the numerically highest concentrations were detected in the deepest sample.

If the total concentration of volatile organic compounds from the sample collected from AB-3 at a 60-foot depth were taken as representative of soil conditions beneath Pit 1, then the following could be concluded:

- total targeted volatile organic compound concentration: 3990 mg/kg;
- total targeted and non-targeted volatile organic compound concentration: 4990 mg/kg; and
- moisture content of soils at the site in the depth range from 40 to 60 feet: 10.66 to 21.80 percent (by weight).

Thus the total concentration of volatile organic compounds represents less than 0.5 percent by weight of the soil mass and is significantly less than the field capacity of the observed moisture content of the soils. Therefore, it is anticipated that the concentration of volatile organic compounds in the soil will not increase significantly with depth. It would be appropriate to assume, for the purposes of the FS, that the entire soil column under Pit 1 to the surface of the basalt is characterized by contaminant concentrations similar to those detected in samples collected from AB-3.

The volume and contamination profile under each pit would be established for the purpose of completing the FS as follows:

- the areal extent of each pit has been determined from trenching operations completed during the RI;
the depth of cover material would be assumed to be 2 feet;

the depth of waste material would be assumed to be 20 feet at each pit;

the chemical composition of the waste would be assessed to be represented by the analytical data from the waste sample from the respective pit;

for Pits 1 and 3, the depth of soil contamination would be estimated to be to the surface of the basalt; and

the depth of contamination for the remainder of the pits would be estimated from the angle boring data.

The "contaminant profile" beneath Pits 1 and 3b/3c is understood sufficiently for the purposes of the FS. Any soil contamination that may occur in the basaltic lava-flow unit would be expected to occur chiefly on fracture surfaces and in weathered zones; investigation of such contamination would be difficult and would be of limited value. Units A and B are below groundwater level, where monitor wells are the appropriate method of investigation, not soil borings.

9C1 "Pooled" liquids were not encountered in any of the soil borings or monitor wells drilled.

9C2 It is possible that, in the past, the basaltic lava-flow unit influenced movement of liquids in the vadose zone at the Site; it is likely that the unit is sufficiently fractured to not have been a substantial influence. Saturated zones were not detected in the vadose zone during drilling operations for the RI.

9C3 Please refer to the responses given above for Specific Comment 9C. The presence of contaminated groundwater indicates that the "contaminant profile" extends to the groundwater level at specific locations.

9C4 Many soil borings have been drilled and sampled at the Site, and the soils encountered were not saturated or near saturation. Potential present sources to provide liquid for gravity drainage were not encountered during the RI. It is possible that potential residual contamination in the deep part of the vadose zone could be a continuing source of groundwater contamination if groundwater levels were to rise into the soils; however, data shown on Figure 23 of the draft report indicate that groundwater levels in Unit A monitor wells have declined during the period of record.
SPECIFIC COMMENT 10. PAGE 4: FT p. 70-71. The discussion of non-targeted compounds detected needs to be expanded. In several samples, high concentrations of non-targeted compounds were detected - primarily hydrocarbons. The presence of these hydrocarbons should be noted in the text, and any implications regarding the presence of these hydrocarbons should be discussed here and in the Fate and Transport section.

RESPONSE: As indicated on pages 67 and 70, non-targeted organic compounds are listed in Tables 14a and 16a. A discussion of non-targeted compounds will be expanded in the appropriate sections of the report.

SPECIFIC COMMENT 11. PAGE 4: p. 73. This summary needs to be revised to reflect previous comments.

RESPONSE: The text on page 73 of the draft report will be changed as necessary to reflect our responses to EPA comments.

SPECIFIC COMMENT 12. PAGE 4: FT 75. The issue of vertical versus lateral spread of contamination needs to be discussed in more detail here and particularly in a Fate and Transport Section. The fact that significant soil contamination has been detected immediately above the basalt, and that groundwater contamination has also been detected, indicates that significant vertical migration of contaminants has occurred. References to the LWE must be removed from the RI report unless the LWE is revised to reflect EPA's comments.

RESPONSE: It is agreed that vertical migration of contaminants has occurred. Further, the Liquid Waste Evaluation suggests that the vertical migration of contaminants is probably through the entire soil column under Pit 1. Reference to the Liquid Waste Evaluation should remain in the RI following revisions to the Liquid Waste Evaluation.
At EPA's request, the following paragraph will be added to the introduction in the RI Report:

Results from a Liquid Waste Evaluation for the Landfill (Conestoga-Rovers & Associates and Montgomery & Associates, 1991) are used to support certain statements made in this RI Report. The Liquid Waste Evaluation was an optional report that was not required by EPA and has, as a result, not been subjected to the EPA review process applicable to the remainder of the RI. Therefore, no representation is given herein with respect to EPA's position on the Liquid Waste Evaluation.

SPECIFIC COMMENT 13, PAGE 4: DL p. 81-85. The RI report should discuss the fact that air sampling was only conducted over a one day period, and that the data gathered is not necessarily representative of conditions at the site during different meteorological conditions. The report should also indicate that Stage II data was collected under atypical conditions (cloudy, after a rain event). Furthermore, the Stage II analytical results section should discuss the fact that contamination was detected, and that some compounds detected during Stage II air monitoring were present at higher concentrations than detected during Stage I air monitoring. It is possible that additional air monitoring may be necessary during the remedial design/remedial action phases.

RESPONSE: It is agreed that the air sampling data collected over the two days of monitoring is reflective only of the conditions on those days, and care should be taken in interpreting these results as representative of annual average conditions.

The EPA comment, however, overstates the "atypical" conditions during the Stage II monitoring. The monitoring occurred two days after a rain event, but meteorological conditions were typical for that time of year.
The Stage II data should be expected to be different than the Stage I data, but these differences turned out to be insignificant. Some further discussion to this effect will be added to the text.

It is agreed that additional air monitoring would be required during the RA phase of the project, provided that the RA completed at the Site involves the potential contact with contaminated soils by on-Site workers.

**SPECIFIC COMMENT 14, PAGE 4:** p. 89. The RI report should include a table with coordinates for monitoring well and soil boring locations.

**RESPONSE:** A list of coordinates for monitor wells and soil borings was submitted on request to EPA in a letter dated October 30, 1990, to Tom Dunkelman. This list will be included in the final report.

**SPECIFIC COMMENT 15, PAGES 4 AND 5:** p. 106, Appendix L, p. 18. Provide further explanation for the estimate of storage coefficient of 0.10 under long-term pumping conditions, when the range under short-term pumping conditions was 0.000015 - 0.000096. A storage coefficient of 0.10 is typical of unconfined aquifers, while a storage coefficient of 0.000015 - 0.000096 is typical of confined aquifers. Please clarify this.

**RESPONSE:** As stated in the report, the magnitudes of storage coefficient computed using data from the 12-hour constant yield pumping tests conducted for the RI are appropriate for such short-term pumping periods. However, representative values for storage coefficient for unconfined aquifers, such as Unit A, under long-term pumping conditions should be estimated using data from long-term pumping tests; "long-term" may include periods of several days to a few months. Longer tests are required to permit sufficient drainage in the zone dewatered by the cone of depression caused by the pumped well. Values of storage coefficient
for unconfined aquifers typically increase toward a limit with increasing time pumped.

It is standard practice to estimate representative values for long-term pumping conditions based on experience in the area and on the types of sediments in the aquifer. Results of hydrogeologic investigations for basin-fill deposits in central Arizona indicate that storage coefficients for these types of sediments typically range from 0.08 to 0.15. In our opinion, a value for storage coefficient of about 0.10 is representative for Unit A at the Landfill under long-term pumping conditions. Text will be added to the RI Report to clarify the estimate for storage coefficient.

**SPECIFIC COMMENT 16, PAGE 5:** p. 105, p. 107, Appendix L. What interpretations can be made from the shape of drawdown and recovery curves for Units A and B?

**RESPONSE:** Except where constant pumping rate was difficult to maintain, the shapes of the drawdown and recovery graphs are typical for short-term, small pumping rate tests in basin-fill deposits in the Salt River Valley.

**SPECIFIC COMMENT 17, PAGE 5:** DL p. 105, p. 107. The aquifer tests provide little or no information regarding the interconnection of Units A and B. Such information may be important during the remedial design/remedial action phases and should be identified as a data limitation/gap.

**RESPONSE:** As stated on page 106 of the report, water levels in Unit A observation wells did not respond to pumping in nearby Unit B pumped wells during the short-term pumping tests. However, Unit A by definition on page 48 is the uppermost fine-grained water-bearing strata of the regional aquifer and is similar to the fine-grained strata of Unit B. The division of the strata into Units A and B is artificial and does
not imply a hydrologic boundary. Therefore, Units A and B are hydraulically connected and water levels in Unit A wells would be expected to respond to pumping Unit B wells under longer term conditions and/or using larger pumping rates. Additional data are not necessary to design and implement a remedial action for groundwater. Text will be added to the RI Report to address interconnection of Units A and B.

**SPECIFIC COMMENT 18. PAGE 5: p. 115.** TCA was detected in MW-8UA. If this is a result of laboratory contamination, please clarify. If not, then this contamination should be noted in the text.

**RESPONSE:** As indicated on page 115 and in Table 30, volatile organic compounds were detected and confirmed only for monitor wells MW-1UA, MW-5UA, and MW-6UA, and for abandoned monitor well HS-1. Trichloroethane (TCA) was detected in one groundwater sample obtained from well MW-8UA; however, TCA was not detected in the duplicate groundwater sample. Therefore, TCA was detected, but not confirmed, for monitor well MW-8UA; a statement to this effect will be added to page 115 of the draft report. Well MW-8UA will be evaluated further during future groundwater monitoring.

**SPECIFIC COMMENT 19. PAGE 5: Table 31.** 1,2 DCE was detected in MW-6UA at 1.2 micrograms per liter according to Table 30, rather than ND as is shown on Table 30. Please clarify.

**RESPONSE:** The data given in Table 30 is correct. The concentration for 1,2-dichloroethene (1,2-DCE) shown in Table 31 for well MW-6UA will be changed from "ND" to "ND-1.2" with a superscript "c", which indicates the compound was detected but not confirmed. 1,2-DCE was detected only in the groundwater sample obtained from well MW-6UA in June 1990. Additional sampling is required to confirm the presence of 1,2-DCE at this well.
SPECIFIC COMMENT 20, PAGE 5: DL p. 111. This section of the RI report should include further discussion of the groundwater sampling methods. Specifically, discuss the impact of using submersible electric pumps as opposed to other non-aerating methods. If the sampling method introduces any bias into the data, then this issue should be discussed in the data gaps and limitations section. In the future, it maybe necessary to revise groundwater sampling methods.

RESPONSE: The use of electric submersible pumps is an effective, appropriate, and accepted method for obtaining groundwater samples from wells. All sampling methods introduce a certain amount of bias into monitoring data. However, most experienced hydrologists feel that the use of electric submersible pumps designated for a project is considered an excellent method for minimizing potential bias inherent in many other methods. Use of submersible pumps for sampling monitor wells is widely accepted and is used at many other sites regulated by EPA. We would consider revision of the sampling method inappropriate.

SPECIFIC COMMENT 21, PAGE 5: p. 117. There are several semi-volatile compounds presented in Table 34 which do not appear to result from laboratory contamination (eg. see MW-2UA, MW-6UA). If these contaminants are a result of laboratory contamination, please clarify. If not, their presence should be noted and discussed in the text.

RESPONSE: Semi-volatile organic compounds detected for monitor wells MW-2UA and MW-6UA were detected in one sample, but not confirmed in duplicate samples or in subsequent samples. Therefore, the statements made on page 117 of the report are correct. As indicated in Table 34, most of the semi-volatile organic compounds detected in monitor wells were detected only in samples obtained during well development operations and may have resulted from the drilling process; no semi-volatile compounds were detected in subsequent samples.
**SPECIFIC COMMENT 22, PAGE 5: FT, DL p. 115, p. 110. The RI should attempt to explain the presence of contamination in MW-1UA. Is this the result of contamination entering the water table from a point beneath Pit 1, or is it the result of contamination entering the water table from another source (Special Pits)? Is there enough information to answer this question? If not, what further information is necessary? Assuming that the source of contamination in MW-1UA is a point beneath Pit 1, would this conflict with calculated groundwater flow velocities? If so, please discuss.**

**RESPONSE: As discussed with EPA throughout this project and as indicated in the Work Plans, because the disposal pit areas constitute a large fraction of the Site area, investigation of individual pits was not considered pragmatic or cost effective. Therefore, the RI was designed to evaluate the entire Site as a potential source of contamination. Because contaminated groundwater has not been detected at monitor wells MW-4UA and MW-7UA, it appears unlikely that Pit 1 could be the source for contaminated groundwater detected at well MW-1UA. A logical conclusion might be that a source for the contaminated groundwater detected at well MW-1UA is north from this well, or between this well and well MW-7UA.

Although it may be useful for source control, is not necessary to know the precise source of contamination at well MW-1UA to select and implement an appropriate remedial action for groundwater. A discussion of this topic will be added to an appropriate section of the final report.**

**SPECIFIC COMMENT 23, PAGES 5 AND 6: FT, DG, DL p. 116, p. 118. The detection of significant contamination in MW-6UA seems to confirm that contamination in HS-1 was not merely a result of improper drilling techniques. This issue needs further discussion. Furthermore, the presence of significant contamination in HS-1 and MW-6UA coupled with an observed downward vertical gradient suggests that groundwater contamination Unit B is**
likely; yet no monitoring wells are installed in Unit B at this location. It cannot be argued that MW-4UB proves a lack of contamination in Unit B, since MW-4UA did not reflect the contamination observed at MW-6UA and HS-1. This represents a significant data gap, and it is possible that groundwater contamination in Unit B could go undetected in light of the current monitoring network. This situation must be remedied.

**RESPONSE:** Results from the RI neither confirm nor refute the concept that contaminated groundwater detected at well HS-1 could have been the result of well construction operations. The Supplemental Work Plan was designed and negotiated with EPA to provide the data necessary for completion of the RI; an additional Unit B monitor well was not included in the Supplemental Work Plan. Three Unit B monitor wells are located in the direction of groundwater movement from the MW-6UA site. Volatile organic compounds have not been detected and confirmed in groundwater samples obtained from these Unit B monitor wells. The existing monitor well network for the hazardous waste area is sufficient, particularly in view of the overall approach to the entire hazardous waste area as a potential source of contamination. CRA indicates that the additional Unit B monitor well is not necessary for proper preparation of the FS Report or for proper design of a potential groundwater remedial action.

If at some point an interim remedial action is considered, it may be desirable to evaluate if an additional Unit B monitor well would be necessary. However, please refer to the response to EPA General Comment 2.

**SPECIFIC COMMENT 24, PAGE 6:** FT, DL p. 115-119. An expanded level of interpretation of the results of groundwater monitoring is needed here and in the Fate and Transport section. The RI should attempt to explain the spatial and temporal patterns of groundwater contamination. It appears that groundwater contaminant levels are increasing over time. This is a very important issue which is not discussed at all. If insufficient data exists to explain contaminant patterns, the RI should state what data would be required to
complete this explanation. Furthermore, questions such as the following should be answered:

- **How are the overlying units affecting spatial and temporal variations in groundwater contamination?**
- **Can the results of the structural-contour analyses be used to explain variations in contaminant patterns?**
- **Why is groundwater contamination generally increasing over time, and what are the implications for site remediation?**
- **Is it possible that the basalt unit is introducing "lag time" into detection of groundwater contaminants?**
- **Is any vertical specification of groundwater contaminants occurring?**

**RESPONSE:** It is not clear that there is a spatial or temporal pattern of the zone of contaminated groundwater. The disposal pit areas constitute a large fraction of the Site area, which is relatively small. The groundwater monitor well network is designed to address the entire Site as a potential source of contamination. Therefore, conclusions concerning a spatial pattern would be speculative and are not necessary for proper selection and implementation of a remedial action for groundwater.

The RI report indicates that contaminated groundwater was detected and confirmed at monitor wells MW-1UA, MW-5UA, and MW-6UA, and at abandoned monitor well HS-1. Inspection of Table 30 indicates that concentrations of volatile organic compounds in wells MW-1UA and HS-1 increased and decreased during the RI; no temporal pattern is evident. Such increases during the first several sampling rounds are not uncommon for monitor wells completed in sediments having low permeability, and are indicative of slow recovery of such wells from the disturbance of drilling operations. This type of increase would appear to be occurring at recently constructed well MW-6UA. Additional sampling rounds would be required to investigate any potential temporal patterns for monitor wells MW-5UA and MW-6UA.
24A Please refer to responses given in the preceding paragraph for Specific Comment 24, and to Specific Comments 9C2 and 9C4.

24B The structural contour analyses can potentially assist in explaining variations in contaminant distribution. The surface of the fine-grained part of the upper alluvial deposits unit (Figure 19) exhibits a depression in the center of the Site, with its lowest part in the vicinity of wells MW-6UA and HS-1. This condition could be interpreted to suggest that contaminants from nearby Pit 1 may have tended to migrate preferentially through the fine-grained unit toward the low part of this area. However, it is not believed that the surface of the fine-grained unit would necessarily act as a preferred transport pathway for waste from the pits.

Structural Contours for the top of the basaltic lava-flow unit show a downward slope to the northeast. A downward slope of the surface of the basaltic lava-flow unit also occurs toward a depression at the west boundary of the Site, and to the southwest toward a depression at the southwest boundary of the Landfill. The basaltic lava-flow unit is believed to be substantially fractured. However, if the fractures would be filled or widely spaced, contaminants may have a tendency to migrate downslope on the surface of the unit.

Vadose zone contamination that may occur in the basaltic lava-flow unit would be expected to occur chiefly on fracture surfaces and in weathered zones. Although it is possible that the basaltic lava-flow unit may have influenced movement of liquids in the vadose zone at the Site, it is likely that the unit is sufficiently fractured to not have been a substantial influence. Saturated zones within the basalt were not detected in the vadose zone during drilling operations for the RI. Also, "pooled" liquids were not encountered in any of the soil borings or monitor wells drilled.

The structural contour analysis is not of obvious use in explaining the contamination detected at well MW-1UA. Please also refer to the response to EPA Specific Comments 4 and 9.

24C Please refer to responses given in the preceding paragraph for Specific Comment 24.

24D Please refer to responses given in the preceding paragraph for Specific Comment 24, and to Specific Comments 9C2 and 9C4.

24E No "vertical speciation" has been detected and would not be expected to be an important process given the relatively small concentrations detected in groundwater and the absence of a floating free-product on the surface of the groundwater in monitor wells.
Discussions of these responses will be added to the appropriate sections of the final report.

**SPECIFIC COMMENT 25, PAGE 6:** p. 129. As is discussed in the General Comment 2 and many of the above Specific Comments, EPA does not necessarily agree with the statement here that "Additional testing for the Feasibility Study outside of the Remedial Investigation is unnecessary." As is discussed above, in General Comment 2 and in several Specific Comments, EPA has identified several potential additional sample requirements.

**RESPONSE:** Any further testing which has been identified by EPA can be readily incorporated into the RD/RA phase of the project but is not necessary or appropriate for incorporation into the FS or the RI. See response to General Comment 2.

**SPECIFIC COMMENT 26, PAGE 6:** Executive Summary. This section should be revised to reflect the comments provided above. At a minimum, the following conclusions need revision:

- p. 5, no. 6. This conclusion needs to be rewritten in light of previous comments;
- p. 6, no. 7. As is discussed in previous comments, references to the LWE must be removed from the RI report unless the LWE is revised to reflect EPA's comments;
- p. 11, no. 14. Based on observed patterns of contamination, it appears likely that groundwater contamination may exist in Unit B in the vicinity of HS-1 and MW-6UA. This issue needs to be addressed here. Also, the fact that groundwater contaminant concentrations are generally increasing over time needs to be addressed.
- p. 12, no. 15 and 16. EPA disagrees with these conclusions.
- p. 12, no. 17. The air monitoring program did detect contamination, and this fact should be noted in this section. Questions pertaining to the relative risk posed by these contaminants will be addressed by the Risk Assessment, and as a result
discussion of this issue is not appropriate in the RI. Conclusion 17 should be
removed.

Those issues raised in the General Comments must be addressed in the Conclusions.

RESPONSE: The "Summary of Results and Conclusions" section of the draft
report will be revised as necessary to reflect our responses to EPA
comments.

26A Where appropriate, changes to conclusions at the front of the
report will be made to reflect changes in the main text.

26B Please refer to the response to Specific Comment 12.

26C Please refer to the response to Specific Comment 24.

26D This comment is noted.

26E Conclusion 17 is a valid interpretation of the data obtained during
the RI. However, at EPA's request, the conclusion will be modified
in accordance with discussions held with EPA on January 8, 1991.

26F Please refer to introductory sentence to this response.
EPA COMMENTS ON THE LIQUID WASTE EVALUATION REPORT

**EPA COMMENT 1:** The amount of subsurface data available significantly limits the capability of the LWE to accurately model site conditions. The issue of limited subsurface data is discussed extensively in the RI comments.

**RESPONSE:** The purpose of CRA’s modeling effort was to develop some indication of the potential migration pathways of liquid waste from the Site. However, knowledge of the input quantities and data regarding the infiltration/desiccation of soil on the bottom of the pits, etc., was extremely limited. Thus, it was decided that a relatively simple model was appropriate for application to examine a range of possibilities and thus provide some focus to the migration pathways utilized by the chemicals. This is also appropriate given the imprecise nature of the manifest database. The quantities reported in the database were estimates by the generators and not based on analytical data.

The modeling was focused on two features: evaporation and infiltration. Thus, once the chemicals infiltrated through the base of the pit, they were assumed lost to the vadose zone (by capture) and/or to the groundwater. In other words, there was no capillary rise effect back to the surface and subsequent evaporation. As well, there was no volatilization of the chemicals trapped in the vadose zone. Both of these migration pathways were not represented in the modeling and in all likelihood would contribute substantially to losses of chemicals back to the atmosphere.

The modeling was sufficiently sophisticated to demonstrate that significant quantities of chemicals were evaporated. Precision on total quantities evaporated is difficult due to the data limitations indicated above.
With limited data on soil stratigraphy, there is little merit in detailed modeling. As well, there is limited data for the input rates of the chemicals.

The Liquid Waste Evaluation report will be amended to include a new Section 1.2 titled "Purpose" which will provide an explanation of the basis of the report and its intended use.

**EPA COMMENT 2:** P. 26, par. 2. The statement, "A representative estimate of evaporation and infiltration is considered by CRA to be the range represented by Case 1 and Case 2," is not adequately supported and appears to be no more than a guess. Unless this statement can be further supported, it should be removed. Furthermore, any conclusions in the LWE and RI report should cite the full range of evaporation and infiltration as represented by Cases 1 through 4.

**RESPONSE:** The full range of modelled values will be presented in the conclusions for the report and will be compared to the data from the RI for groundwater contamination and soil data.

**EPA COMMENT 3:** P. 26, par. 3. The following sentence must be removed from the LWE: "Further, the results of the RI for the Site do not indicate the presence of significant quantities of waste material in the groundwater." Groundwater contamination at the site exceeds MCLs for several contaminants, thus indicating the presence of significant contamination. Furthermore, given the current network of monitoring wells and the fact that the basalt unit is likely to slow contaminant movement, it is possible that larger amounts of liquid waste have gone undetected.

**RESPONSE:** The sentence will be revised. It is agreed that groundwater contamination at the Site exceeds the maximum contaminant limit (MCL) for several contaminants. However, the text will indicate that the mass
of contaminants detected to be in solution in the groundwater to date does not correspond to substantial quantities of organic compounds. As an illustration, if it was assumed that the entire Unit A aquifer (approximately 36 feet thick with an assumed porosity of 0.3) under the Site (approximately 370,000 ft$^2$) was contaminated with volatile organic compounds at a concentration similar to that at MW-6UA (660 μg/l), then the approximate weight of contaminants could be calculated as:

$$\text{Site area (ft}^2\text{)} \times \text{aquifer thickness (ft)} \times \frac{m^3}{35.315 \text{ ft}^3} \times 0.3 \times \frac{1000L}{m^3} \times \frac{660\mu g}{9 \times 10^9 \mu g} = 74.7 \text{ kg}$$

New text in the Liquid Waste Evaluation will indicate that this (over-estimated) small quantity of waste material, which was estimated to be dissolved in the groundwater, supports the conclusion that a substantial proportion of the wastes either evaporated or were absorbed into soil below the disposal pits.

It should be noted that, where appropriate, the Liquid Waste Evaluation utilized available and historic data to estimate evaporation and infiltration. Where the data were not available, conservative assumptions were utilized that would tend to favor infiltration.

**EPA COMMENT 4:** P. 27, par. 2 and 3. As was discussed previously, EPA does not agree with the representative range concept. Also, EPA disagrees with the statement that the representative ranges are an over-estimate. Based on comments provided it is possible that the LWE may have significantly underestimated infiltration at the site. The fact that significant soil contamination has been detected immediately above the basalt, and that groundwater contamination has also been detected, indicates that significant vertical migration of contaminants has occurred.

**RESPONSE:** See response to EPA Comment 2. The modeling results indicate that there was significant vertical infiltration, in addition to the evaporation. The important understanding gained from the modeling is
that the percentage lost to evaporation is not trivial. As to what happened to the chemicals that infiltrated, the model was not designed to explore this. Some quantity was definitely adsorbed, captured in soil interstices, volatilized, etc. Detailed modeling of these subsequent phenomena is pointless without field data, because the migration pathways are too complicated to accomplish without field calibration.
PRC COMMENTS ON THE LIQUID WASTE EVALUATION REPORT

**PRC GENERAL COMMENT 1:** These phenomena compete simultaneously for the wastes, and should be modeled as occurring simultaneously in an integrated model. However, each phenomenon was treated separately. *A more detailed evaluation is needed to determine the effect of separating these phenomena on the result.*

**RESPONSE:** The need for simultaneous computations is solely dependent upon a comparison of the "rate of change" relative to the time increment used in the model calculations. Because the model calculations are carried out on a daily time increment, as long as the rate of change relative to this time increment is small, then the modeling of the seepage and evaporation components need not be calculated simultaneously. The changes in contents of the pit over a single day are considered sufficiently small that the numerical complexity of simultaneous computations is unnecessary.

Further, CRA is not aware of any validated models currently available that incorporate all these phenomena.

**PRC GENERAL COMMENT 2:** In general, the models used are too simplistic and based on unsupported assumptions. Therefore, the results will not be used to support the risk assessment.

**RESPONSE:** Sophistication in available models is not sufficient to overcome a very limited database. The number of variables that need to be assigned for a sophisticated model is enormous. Instead, a simple model was utilized to "screen out" the variables and thus serve to direct appropriate future data collection efforts.
The Liquid Waste Evaluation was never intended to support the Risk Assessment. It is assumed that the Risk Assessment will be based on measured RI data.

**PRC GENERAL COMMENT 4: Page 10. Sec. 2.4, par. 2.** CRA accurately states that "the amount of adsorption onto subsurface soils is a function of soil type and the amount of natural organic carbon in the soil." The organic carbon fraction is probably more important in determining adsorption, however, this parameter is never mentioned again in the text or used in calculation of adsorption.

**RESPONSE:** The organic carbon levels are low (total organic carbon approximately 0.008 or 0.8%) and therefore this component was not utilized. In soils with this range of organic carbon, the specific surface area of the fine-grained soil components are more influential on chemical adsorption than the FOC (Karickhoff et. al., 1979; Schwarz-enbach and Werstall, 1981).

However, once lost to seepage below the pit, the modeling terminates. A series of processes are potentially relevant, including impermeable lenses, ganglia, adsorption, etc.

A simple means for examining the capture potential is that all of the volume of the chemicals added to the individual pits is less than the pore space below (assuming a uniform wetting front) to the water table. The relative volumes as computed does not account for losses to evaporation, or volatilization from the vadose zone.

A section on the organic carbon fraction and the soil partition coefficient will be added to the text.
**PRC SPECIFIC COMMENT 2:** Figure 3. The amount of sand in the shallow UAD unit and in Unit A (between 40% and 60% at 70 feet to 80 feet BLS in well 4UA) should be reflected in the descriptions, similar to the siltstone interbeds described in the upper UAD unit.

**RESPONSE:** CRA concurs with this comment and will revise Figure 3.

**PRC SPECIFIC COMMENT 3:** Table 3. The heat of vaporization values used are questionable. The values presented for different compounds are not standardized to a reference temperature. Reference temperatures for the heat of vaporization values range from 13°C to 148°C. The reference temperature should correspond to a typical average temperature at the site.

**RESPONSE:** The reference temperatures relate to the boiling temperature of the respective compounds. Adjustment of the values through a calculation (see Perry's Chemical Engineers' Handbook, fifth edition, equation 3-53) would modify these latent heat by less than 5% and there would be an insignificant change in the precision of the model given to other data limitations. The text will be amended to clarify this.

**PRC SPECIFIC COMMENT 4:** Section 4.2. Seepage Model. It is not clear why so few models were screened for applicability. Each of the three analytical models are very simple and do not consider the alluvial heterogeneities present at the site. If the present site characterization does not support more rigorous modeling activities, modeling should be based upon very health conservative assumptions to fill data gaps.

**RESPONSE:** Again, the model was not focused on the alluvial heterogeneities, but simply attempted to characterize the infiltration of fluids through the bottom of the pits.
The Liquid Waste Evaluation utilized data from the RI where they were available. Where data were not available, conservative assumptions were utilized that would tend to favor infiltration. See response to PRC Specific Comment 6.

A succession of assumptions even more conservative than those used in the Liquid Waste Evaluation would tend to produce even greater overestimates than those developed in the Liquid Waste Evaluation; thus, artificially elevating a situation that is not a health concern to an apparently significant health concern. The model results have been consistent with the data obtained to date.

**PRC SPECIFIC COMMENT 5:** Page 19, Section 4.2. Although the equation used to calculate the seepage rate is given as:

\[ f_p = \frac{K(H + L + S)}{L} \]

where \( f_p \) is the seepage rate and \( K \) is vertical hydraulic conductivity, the relationship really used to calculate the seepage rate is:

\[ f_p = K \]

This should be made clear in the report.

**RESPONSE:** Clarification of the report will be undertaken to indicate this. The rationale for this approach is that if the depth of ponding and capillary suction term are small relative to the saturated hydraulic distance, then \( (H+L+S)/L = 1 \). The utilization of this approximation is tied directly into the use of the saturated hydraulic conductivity. If \( L \) is small, then the use of the saturated hydraulic conductivity term is inappropriate; two-phase flow (at least) must be utilized and the
ramifications to the hydraulic conductivity included in the modeling. If \( L \) is large, then the assumption of saturated hydraulic conductivity is appropriate but also, so is the assumption that the hydraulic gradient is unity.

**PRC SPECIFIC COMMENT 6:** Page 20, Paragraphs 1 and 2. The text maintains that the inwash of fine materials will seal the bottom of the impoundments preventing further infiltration of contaminants. This inwash effect probably occurred at the site, however, if any of the pits were allowed to dry completely the formation of desiccation mud cracks would significantly enhance infiltration. Therefore the ability of the inwash effect to prevent significant amounts of infiltration is suspect.

**RESPONSE:** If the pits dried out, the opportunity for significant cracking would have occurred; unfortunately, records are not available to quantify this. Nevertheless, inwash must certainly have occurred. Therefore, if the pits cracked, then to an extent evaporation must have occurred to create the drying.

It is also to be noted that even if cracking did occur, the next load of chemical would create new inwash into the cracks and the cycle would repeat.

The text does not state that infiltration would be prevented by inwash. The Liquid Waste Evaluation states that this inwash effect would have reduced infiltration but it was not included in the calculations.

It is also important to realize that a conservatively high infiltration rate was utilized, with knowledge that the inwash would decrease the infiltration. Thus, the estimation of evaporation in the Liquid Waste Evaluation would be conservatively low.
This conservatively low estimate is evidenced by the fact that the Liquid Waste Evaluation utilized a constant value for the hydraulic conductivity (see PRC Specific Comment 7) which was derived from laboratory measured values for soil samples from the Site. These laboratory measured values may tend to over-estimate the in situ hydraulic conductivity because the laboratory may not be able to achieve absolutely the conditions of stratification and compaction present under in situ conditions. The hydraulic conductivity value is further considered to be a high estimate due to the fact that the inwash effect has not been considered. Thus, the soils would permit a smaller quantity of liquid waste to infiltrate and more liquid wastes would evaporate than estimated.

**PRC SPECIFIC COMMENT 7**: Page 20, Paragraph 3. Using a hydraulic conductivity value of $4.5 \times 10^6$ cm/s derived from laboratory tests may under-estimate the true value for hydraulic conductivity. Values derived from pump tests indicate that laboratory values are significantly lower than actual values. For example, values provided for hydraulic conductivity of Unit A differ considerably between those obtained in the laboratory and those derived from the pump test. Tests of a sample (25% sand and 80% silt and clay) obtained from between depths 74.5' - 90.5' at well MW-5UA resulted in a hydraulic conductivity value of $1.99 \times 10^6$ cm/s (Pg. 97, RI), whereas pump tests for MW-5UA resulted in a value reported as 35 gpd/ft², which when converted is $1.66 \times 10^3$ cm/s (Page 105, RI). According to Heath (1987), these values represent the low and high end respectively of hydraulic conductivity values for silt. Since there is so much variation between values, it seems that the value reflecting more realistic conditions should be used. The larger value may reflect a sandy component which correlates well with the lithology description. Thus, if laboratory tests under-estimate the true hydraulic conductivity, then the calculated seepage rate used in the model could be under-estimated by three orders of magnitude. Heath (1987) also indicates that hydraulic conductivity in a basalt lava flow varies greatly depending on the amount of fracturing, but can be as high as 1 cm/s.
RESPONSE: The comment incorrectly compares laboratory-measured values for vertical hydraulic conductivity with field-measured values for horizontal hydraulic conductivity.

Further, the horizontal and vertical hydraulic conductivity values referred to are for the units below the basalt. These units were not utilized to estimate the volume of soil available to accept chemicals.

The model did not calculate the amount of material that may have been transported on or through the basalt.

**PRC SPECIFIC COMMENT 8:** Detection of VOCs in HS-1 in 1982 indicates that a higher seepage rate than the 0.15 in/day (or, metrically, 4.5 x 10^-6 cm/s) calculated by CRA may be more realistic. Also, the heterogeneity of the sediments in the UAD unit may be important in evaluating the variation of hydraulic conductivity in the formation. Coarser-grained channel deposits can provide pathways of enhanced migration. Also, the hydraulic gradient is assumed to be 1.0 without any explanation.

RESPONSE: The model does not characterize the pathway mechanism once the chemical has infiltrated through the bottom profile of the pit. There are several additional effects not considered in the model:

- capillary effect back up to the surface in the event of the bottom drying out;
- adsorption to soil particles and then volatilization from the pore spaces; and
- perched quantities on impermeable soil strata.

This comment might also support the notion that the installation of HS-1 acted as a mechanism to transport contaminants to the groundwater.
**PRC SPECIFIC COMMENT 9:** Section 4.3. This section is labeled "Adsorption Model". This model does not simulate adsorption or any other chemical process. It is applicable only to aqueous system. The model consists of:

\[(\text{saturation porosity} - \text{specific yield}) - \text{moisture content} = \text{potential storage (specific retention)}\]

For an aqueous system this model assumes that the moisture content of the soil is not in equilibrium with a passing wetting front. If a wetting front has passed through these sediments within the last several decades their moisture content may approximate the specific retention. If so, the specific yield of the sediments ranges from 4% to 30% with an arithmetic mean of 16.44% excluding the sample from less than 38 feet in depth. Therefore the specific yield values assumed by the model are low and the potential storage calculation is meaningless. If a specific yield value of 16.44% is used in the model, 5 of the 10 samples would have negative potential storage. The concept of potential storage may be applicable to surficial sediment subject to desiccation but it is not applicable to sediments at depth.

**RESPONSE:** The model was used to develop an order of magnitude to put the migration pathways into context. It is not suggesting that the concentration at specific locations is known; an averaging assumption is implied.

We have assumed only vertical migration, whereas lateral spread will have occurred, particularly in light of impermeable lenses.

**PRC SPECIFIC COMMENT 10:** The model does not simulate contaminant transport or calculate the amount of contaminant storage. There are a number of reasons for this.

- Some organic contaminants will displace adsorbed water off the soil adsorption sites. The model assumes that water will out-compete all the organics for the adsorption sites. Preferential adsorption of some contaminants could increase the amount retained within the unsaturated zone.
The model assumes that the soil will have the same specific retention of contaminants that it does for water. Many organic contaminants, especially solvents, have lower viscosities than water. This means that some contaminants will flow through pore space where water will become entrained due to capillary force. The net result is that the specific retention by the soil of the contaminant will be smaller, by volume, than the specific retention of water.

The model assumes that the contaminants will migrate as a uniform wetting front, however many contaminants will migrate as ganglia. Contaminant migration as ganglia will significantly reduce the amount entrained within the unsaturated zone.

RESPONSE: The type of modeling implied by the comments is not in an operational level anywhere. CRA personnel have been involved in the modeling of individual ganglia. However, the data needs for application to a field site with variable stratigraphy are enormous. Even if the input conditions were known, the modeling results would not be supportable without field data for calibration and verification.

PRC SPECIFIC COMMENT 11: A number of other factors will influence the migration of the contaminants including pooling of contaminants on impermeable lenses, cosolvation effects, and fracture flow effects within the basalt. The amount of uncertainty introduced by the factors described above render the model used unreliable. A more reasonable approach may be to chose several indicator chemicals, model their potential for migration and then generalize the results to other contaminants.

RESPONSE: The utilization of individual chemicals followed by generalizations could also be criticized as unrepresentative of overall conditions.

Given the uncertainties in the data and the objectives of the Liquid Waste Evaluation and the data from the RI, the results can be relied upon to indicate that a substantial proportion of the liquid wastes evaporated or are absorbed in the subsurface soils.
PRC SPECIFIC COMMENT 12: Also, based on Heath (1987) the specific yield of 0.01 used in the model is half the typical value used for clay. Therefore, based on the lithology, use of this value probably leads to an under-estimate of the amount of contamination available for migration to the groundwater. The higher specific yield value of 0.10 used in Cases #3 and #4 is more appropriate, but may still be an under-estimate.

RESPONSE: The range of specific yield values assumed (0.01 to 0.10) was based on RI data. The true values for specific yield of the fine-grained part of the upper alluvial deposits unit at the Site are expected to be within this range.

Heath (1987) is an elementary primer on hydrology and is not a comprehensive source for representative data on specific yield of clay; the value 0.02 for specific yield cited by Heath (1987) is identified as a "selected value". Walton (1970) provides a more comprehensive text and indicates that the range for specific yield for clay is 0.01 to 0.10, which is precisely the range used for the model.

PRC SPECIFIC COMMENT 13: Page 24. If the more volatile compounds were also more dense, the assumptions of mixing may also have acted to over-estimate the amount of wastes evaporated.

RESPONSE: An assessment of the stratification effects will be included in the revised Liquid Waste Evaluation.
ATTACHMENT 2

RESPONSES TO COMMENTS BY
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

The following responses are to Arizona Department of Environmental Quality (ADEQ) comments, dated November 9, 1990, on the draft Remedial Investigation (RI) Report, dated October 11, 1990, and the Liquid Waste Evaluation, dated October 9, 1990, for the hazardous waste area (the Site) at the Hassayampa Landfill (the landfill), Maricopa County, Arizona. ADEQ comments are referenced by the sequential number of the comment and/or the page on which it is given in the ADEQ document. Responses were prepared by Errol L. Montgomery & Associates, Inc. (M&A) and by Conestoga-Rovers & Associates (CRA).

COMMENT A1, PAGES 1 AND 2: As I have commented before in previous submittals (copy of May 30, 1989 memo to Kristie Kilgore of ADEQ from myself is given as Attachment 1) regarding the fate of liquid wastes upon disposal at the Hassayampa Landfill, it has long been my opinion that the estimates of liquid waste evaporation, retention in the vadose zone, and lateral migration in the vadose zone are all overestimated. As a result of the Technical Work Group Meeting on August 8, 1989 at EPA Region 9 headquarters in San Francisco, California, members of Errol Montgomery and Associates (EMA) and myself once again agreed on very few aspects concerning the fate of liquid wastes upon disposal at Hassayampa Landfill. However, we did agree that the proposed slant borings (at the time slant borings had not been installed) beneath each pit would determine what had actually happened to the liquid wastes discharged into the pits.

Laboratory results of the samples obtained from slant boring completion beneath each disposal pit have been summarized on page 5 of the RIR. As is evidenced by the data, a great deal of both HVOC and semi-VOC contamination exists to the bottom of the angle borings completed beneath Pits 1 and 3 (both of which received a large amount of liquid
Based upon the site-specific facts, it appears that a great deal of soil contamination beneath Pits 1 and 3 has occurred along with the non-detect of these contaminants in soil borings surrounding these pits. These facts suggest that very little lateral migration of contaminants occurred in the vadose zone upon percolation.

RESPONSE: ADEQ comments on the draft Stage I Report and draft Supplemental Work Plan and responses to comments were given as Attachments 2a and 2b, respectively, of the document dated October 5, 1989, and entitled RESPONSES TO COMMENTS ON DRAFT STAGE I REPORT AND DRAFT SUPPLEMENTAL WORK PLAN FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY, HASSAYAMPA LANDFILL HAZARDOUS WASTE AREA, MARICOPA COUNTY, ARIZONA. We disagree with the part of this comment that states liquid waste evaporation, vadose zone retention, and lateral migration were overestimated (please refer to responses to EPA comments, given in Attachment 1 of the present responses). The remainder of the comment is noted.

COMMENT A2, PAGE 2: My opinion on the occurrence of HVOC contaminants detected in ADEQ monitor well HS-1 remains the same as is contained in Attachment 1. Subsequent detection of high concentrations of HVOC's in MW-6UA (which was installed in place of HS-1 after HS-1 was abandoned in 1988) would appear to confirm that improper drilling techniques for HS-1 were not responsible for the presence of HVOC's in this well, and would also tend to support the theories of subsurface contaminant migration presented in Attachment 1.

RESPONSE: Results from the RI neither confirm nor refute the concept that contaminated groundwater detected at well HS-1 could have been the result of well construction operations. Please also refer to our responses given in Attachment 2b of the document dated October 5, 1989, and entitled RESPONSES TO COMMENTS ON DRAFT STAGE I REPORT AND DRAFT SUPPLEMENTAL WORK PLAN FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY, HASSAYAMPA LANDFILL HAZARDOUS WASTE AREA, MARICOPA COUNTY, ARIZONA.
COMMENT A3, PAGE 2: It is unclear whether or not page 35 of the RIR has taken into account the several thousand gallons of solvents which were disposed into the Special Pits Area.

RESPONSE: The data tabulated on page 35 of the RI Report was obtained from Arizona Department of Health Services (1985). It is assumed that this data includes solvents designated for disposal in Special Pits. Appendix B of the draft report contains the Bureau of Waste Control inventory of wastes designated for disposal in the Special Pits.

COMMENT A4, PAGE 2: My opinion of the locations of monitor wells MW-7UA (well B) and MW-8UA (well C) remains the same as stated in Attachment 1.

RESPONSE: Please refer to our responses given in Attachment 2b of the document dated October 5, 1989, and entitled RESPONSES TO COMMENTS ON DRAFT STAGE I REPORT AND DRAFT SUPPLEMENTAL WORK PLAN FOR REMEDIAL INVESTIGATION / FEASIBILITY STUDY, HASSAYAMPA LANDFILL HAZARDOUS WASTE AREA, MARICOPA COUNTY, ARIZONA.

GENERAL COMMENT B: The purpose of this report is unclear. The report attempts to show that much of the liquid waste disposal into the pits should have evaporated, resulting in very little or no contaminant migration to the underlying aquifer. However, since there is not enough subsurface soil contamination information to verify the results of the modeling, the merit of the modeling effort is questionable. It is time to face the facts, soil and groundwater contamination does exist at the site as a result of waste disposal activities, and further efforts (whether site investigation or remedial) should focus on the eventual clean up of the site.

RESPONSE: Please refer to the response to EPA General Comment 1 given in Attachment 1 of the present responses. The Liquid Waste Evaluation
(CRA and M&A, 1990) does not contradict data in the RI Report, which indicate soil and groundwater contamination occurs at the Site.

**COMMENT B1:** Page 20 of the LWE states that the vertical hydraulic conductivity value used in the evaporation model was obtained from a single boring (SB-14) located on the eastern boundary of the landfill. Basing a major component of the evaporation model on a permeability test from one discrete depth (25 feet) at a single point in my opinion is quite inadequate. Additional permeability tests on shallow soil samples are needed from various areas at the site in order to determine such an important component to the evaporation model.

**RESPONSE:** The use of the vertical hydraulic conductivity from soil boring SB-14 was based on an assumption that it was necessary to estimate this parameter from soil samples collected from a location unaffected by site activities. Therefore, soil boring SB-14 was drilled and sampled outside of the immediate area of liquid waste disposal. CRA considers this assumption and approach to be reasonable and valid.

**COMMENT B2:** Page 22 of the LWE states that the migration front of contamination in the vadose zone would move at a rate of 2:1, vertical to horizontal. It is my opinion that very little horizontal movement would occur in the vadose zone for the reasons given in Attachment 1. In addition, it is well known that upon discharge into a homogeneous media a liquid will move primarily in a vertically downward direction with very little horizontal movement, regardless of higher permeabilities in the horizontal direction. The volume of contaminated soil predicted for the model is therefore too high and greatly overestimates the amount of liquid waste retained in the vadose zone, and consequently greatly underestimates the ability of liquid waste to reach the underlying aquifer.

**RESPONSE:** The comment on this assumption is not supported by the soil and groundwater chemical data or the lithologic data from the RI.
Strata beneath the pits are layered and heterogeneous. Please refer to the responses to EPA Specific Comment 24 and General Comment 2 given in Attachment 1 of the present responses.

**COMMENT B3:** Page 26 of the LWE states that the results of site investigation activities do not indicate the presence of significant quantities of waste material in the groundwater. Firstly, significant quantities of waste material have been detected in the groundwater since MCL's have been exceeded for some constituents. Secondly, due to the slow rate of contaminant movement in the aquifer along with the fact that monitor wells are not properly situated to intercept areas of the contaminant plumes which would be expected to have the highest HVOC concentrations, it is still unknown whether or not large amounts of liquid wastes have reached the underlying aquifer.

**RESPONSE:** Please refer to the response to EPA General Comment 2 given in Attachment 1 of the present responses.

**COMMENT C1, PAGE 3:** My recommendation previously given in Attachment 1 regarding soil boring completion remains the same except for the notable exclusions given below.

- The slant borings appear to be adequate for detecting contamination directly beneath the pits, and therefore nothing should be altered from the way that the original slant borings were installed. Delineation of the pit dimensions helped greatly in the effectiveness of the original slant borings to detect subsurface contamination from liquid waste disposal in the pits.

- Of the four pits identified, only 1 and 3 require additional subsurface soil investigations. This determination is based upon the results of the original soil boring program.

**RESPONSE:** This comment is noted, with the exception that we disagree with recommendations for further soil investigations during the RI/FS. EPA has agreed that additional soil borings are not required. Please
refer to the response to EPA General Comment 2 given in Attachment 1 of the present responses.

COMMENT C2, PAGE 3: My recommendations previously given in Attachment 1 regarding monitor well installation remain the same. Due to the detection of the HVOC contaminants in MW-6UA it recommended that monitor wells D and E also be completed at their originally prescribed locations.

RESPONSE: The decision to not construct optional monitor wells D and E was approved by EPA, ADEQ, and the Respondents based on data obtained from monitor well MW-6UA.

COMMENT C3, PAGE 4: Source(s) of HVOC contamination in the Special Pits Areas needs to be determined. A soil gas and/or soil boring program needs to be implemented in order to effectively site remedial facilities for eventual vadose zone clean-up.

RESPONSE: Please refer to the response to EPA General Comment 2 given in Attachment 1 of the present responses.
RESPONSES TO COMMENTS BY
ARIZONA DEPARTMENT OF WATER RESOURCES

The following responses are to Arizona Department of Water Resources (ADWR) comments, dated November 7, 1990, on the draft Remedial Investigation (RI) Report, dated October 11, 1990, and the Liquid Waste Evaluation, dated October 9, 1990, for the hazardous waste area (the Site) at the Hassayampa Landfill (the landfill), Maricopa County, Arizona. ADWR comments are referenced by the sequential number of the comment and/or the page on which it is given in the ADWR document. Responses were prepared by Errol L. Montgomery & Associates, Inc. (M&A).

COMMENT 1: Page 12, First Paragraph. Nitrate ion may not be related to past disposal activities at the Hassayampa Landfill, however, the treatment of nitrate ion must be at least considered in the feasibility study alternatives if groundwater treatment is necessary.

RESPONSE: This comment is noted for further consideration during the Feasibility Study (FS).

COMMENT 2: Page 48, Basaltic Lava-Flow Unit. Were any tests performed to determine the porosity of the basaltic lava flow? Do the fractures within this unit serve as pathways for contamination migration?

RESPONSE: Porosity tests for the basaltic lava-flow unit were not included in the Work Plans approved by EPA and were not conducted. It is likely that fractures, if open, in the basaltic lava-flow unit provide potential pathways for movement of contaminants, groundwater, and air.
COMMENT 3: Table 40, Preliminary Evaluation of Remedial Action Technologies Hassayampa Landfill RI/FS, Page 2, Treated Groundwater Disposal. Some of the disposal options outlined in this section (such as discharge to surface water and discharge to the sewage effluent pipeline for the Palo Verde Nuclear Generating Station) are not consistent with the water management plans and goals of the Phoenix Active Management Area.

RESPONSE: This comment is noted and will be considered during the FS.
LIST OF SUBSTANTIVE REVISIONS TO
DRAFT REMEDIAL INVESTIGATION REPORT
WITH REFERENCES TO COMMENTS BY
U. S. ENVIRONMENTAL PROTECTION AGENCY

The following list gives specific substantive revisions to the draft Remedial Investigation (RI) Report, dated October 11, 1990, for the hazardous waste area (the Site) at the Hassayampa Landfill (the landfill), Maricopa County, Arizona. The list indicates where a revision is responsive to U. S. Environmental Protection Agency (EPA) comments, dated November 26, 1990, on the draft RI Report. EPA comments are referenced by the sequential number of the comment and/or the page on which it is given in the EPA document. Locations of revisions in the final RI Report, dated February 7, 1991, are given after each EPA comment reference. Revisions to the draft RI Report were prepared by Errol L. Montgomery & Associates, Inc. (M&A) and by Conestoga-Rovers & Associates (CRA).

GENERAL COMMENT 2, PAGE 1:
See page 14, bullet #15. See page 138, section on FEASIBILITY STUDY TESTING PROPOSAL.

SPECIFIC COMMENT 1, PAGE 2:
See pages 37-38.

SPECIFIC COMMENT 2, PAGE 2:
See pages 50-51, section on UPPER ALLUVIAL DEPOSITS UNIT. See pages 139-152, section on CONTAMINANT TRANSPORT AND FATE.

SPECIFIC COMMENT 3, PAGE 2:
See pages 51-52, section on BASALTIC LAVA-FLOW UNIT. See pages 54-55, section on STRUCTURAL CONTOURS.

SPECIFIC COMMENT 4, PAGE 2:
See pages 51-52, section on BASALTIC LAVA-FLOW UNIT. See pages 54-55, section on STRUCTURAL CONTOURS. See pages 139-152, section on CONTAMINANT TRANSPORT AND FATE.

SPECIFIC COMMENT 6, PAGE 3:
See page 63, last paragraph, and page 81, last paragraph.

SPECIFIC COMMENT 7, PAGE 3:
See page 64, first paragraph.
SPECIFIC COMMENT 8, PAGE 3: See page 70, last paragraph, and page 77, first bullet SUMMARY section.

SPECIFIC COMMENT 9, PAGES 3 AND 4: See pages 139-152, section on CONTAMINANT TRANSPORT AND FATE.

SPECIFIC COMMENT 10, PAGE 4: See pages 139-152, section on CONTAMINANT TRANSPORT AND FATE.

SPECIFIC COMMENT 11, PAGE 4: See page 77, first bullet of SUMMARY section.

SPECIFIC COMMENT 12, PAGE 4: See page 19. See page 80, last paragraph, third sentence. See pages 139-152, section on CONTAMINANT TRANSPORT AND FATE. Also note that the Liquid Waste Evaluation is being revised to reflect EPA comments.

SPECIFIC COMMENT 13, PAGE 4: See page 90, third, fifth, and sixth paragraphs. See page 138, section on FEASIBILITY STUDY TESTING PROPOSAL.

SPECIFIC COMMENT 14, PAGE 4: See page 50, first complete paragraph, third sentence.

SPECIFIC COMMENT 15, PAGES 4 AND 5: See page 112, first paragraph.

SPECIFIC COMMENT 17, PAGE 5: See page 114, second paragraph.

SPECIFIC COMMENT 18, PAGE 5: See page 122, second paragraph, third and fourth sentences.

SPECIFIC COMMENT 19, PAGE 5: See Table 31.

SPECIFIC COMMENT 22, PAGE 5: See pages 138-152, section on CONTAMINANT TRANSPORT AND FATE.

SPECIFIC COMMENT 23, PAGES 5 AND 6: See page 138, section on FEASIBILITY STUDY TESTING PROPOSAL.

SPECIFIC COMMENT 24, PAGE 6: See pages 124-125, section on SPATIAL AND TEMPORAL PATTERNS. See page 126, second paragraph, third and fourth sentences. See pages 139-152, section on CONTAMINANT TRANSPORT AND FATE.

SPECIFIC COMMENT 25, PAGE 6: See page 138, section on FEASIBILITY STUDY TESTING PROPOSAL.

Last sentence p. 80 - ok vs. LWE - don't like
SPECIFIC COMMENT 26, PAGE 6:

26A: See bullet #6 in SUMMARY OF RESULTS AND CONCLUSIONS.

26B: See page 19. Also note that the Liquid Waste Evaluation is being revised to reflect EPA comments.

26C: Pages 11-12, bullet #13. See pages 122 and 126.

26D: See page 14, bullets #15 and #16.

26E: See pages 14, bullets #15 and #16.

26F: See page 14, bullet #15.

ADDITIONAL REVISIONS:

Page 49, last bullet.

Page 51, section on UNIT A, fifth sentence.

Pages 51-52, section on UNIT B, sixth sentence.

Page 135, last sentence on page. Table 39a was added to summarize concentrations of compounds of concern detected in soil samples.
The following list gives specific substantive revisions to the draft Liquid Waste Evaluation (LWE) Report, for the hazardous waste area (the Site), at the Hassayampa Landfill (the landfill), Maricopa County, Arizona. The list indicates where a revision is responsive to the U.S. Environmental Protection Agency (EPA) comments, dated November 26, 1990, on the draft LWE Report. EPA comments are referenced by the sequential number of the comment and/or the page on which it is given in the EPA document. Locations of revisions in the final LWE Report are given after each EPA comment reference. Revisions to the draft LWE Report were prepared by Errol L. Montgomery & Associates, Inc. (M&A) and by Conestoga-Rovers & Associates (CRA).

EPA Comment #1, page 25: See page 2, new section 1.2.
EPA Comment #2, page 26: Statement removed. See page 32.
EPA Comment #3, page 26: See pages 33-34.
PRC General Comment #2, page 28: See page 3, paragraph 4.
PRC General Comment #4, page 29: See page 11, last paragraph.
PRC Specific Comment #2, page 29: See Figure 3.
PRC Specific Comment #3, page 30: See page 18, last paragraph.
PRC Specific Comment #5, page 31: See page 22, second paragraph.
PRC Specific Comment #9, page 34: See page 3, paragraph 3.
PRC Specific Comment #13, page 37: See pages 28-30 & Table 6 (Section 4.5)

The following revisions are a result of oral comments by the ADEQ:
Table 5 - calculated storage for Special Pits
page 26 - last paragraph of point 6 (Section 4.3)
Section 4.4
Table 6 - new.
page 29.
Tables 7 & 8 - additions for Special Pits.
Section 6.0 - addition for Special Pits.