



February 12, 1993

Steven H. Wisness  
Tri-Party Agreement Manager  
U.S. Department of Energy  
Mail Stop A5-15  
Richland, Washington 99352

Re: EPA Comments on Appendix D of the Hanford Site Groundwater  
Background Document, DOE/RL-92-23, Draft A.

Dear Mr. Wisness:

The U.S. Environmental Protection Agency and our contractors have reviewed appendix "D" of the "Hanford Site Groundwater Background" document. Enclosed are our comments. With the transmittal of these comments, we consider our review of the first draft of the "Hanford Site Groundwater Background" report to be complete. If you have any questions, please contact me at (509) 376-9884.

Sincerely,

*Laurence E Gadbois*

Laurence E. Gadbois  
Environmental Scientist

Encl: (1) EPA Comments on Appendix D of "Hanford Site Groundwater Background", DOE/RL-92-23, Draft A.

Copy: Mike Thompson, DOE  
Chuck Cline, Ecology  
David Jansen, Ecology  
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Administrative Record, M-28-04



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**EPA Comments on Appendix D of  
"Hanford Site Groundwater Background", DOE/RL-92-23, Draft A**

**GENERAL COMMENTS:**

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1) We find this report to be a wide ranging discussion of the geochemistry of the Pasco Basin and Hanford site. The report goes into detail on numerous tangents describing aspects of the geochemical framework that are of general interest to the Hanford site hydrologic conceptual model, but are not particularly pertinent to the primary purpose of the report, which we understand to be a definition of the quality of ground water upgradient of the Hanford site waste management units. Many of these tangential subjects discussed in the body of the report and in Appendix D contain conclusions that are not fully supported by the data or our understanding of the Hanford site hydrologic flow system. We evaluated these issues and made minor editorial and technical comments on them. We could have consulted with USGS research geochemists and commented much more extensively on these subjects, but due to time constraints and the fact that we believe these subjects to be somewhat peripheral to the main purpose of the report, we have not made an effort to comment extensively on them. We suggest that it would be appropriate at the time of the next unit managers meeting to have a meeting with the authors to discuss the purpose of this report and to determine whether the rock-water interactions studies, chloride mass balance, and isotopic evaluation are necessary to include in this report and therefore worthy of a full review.

2) The main purpose of the report is addressed in Section 5.4. This section and the associated Appendix B and table 5-9 were all written before the release of the Model Toxics Control Act (MTCA) Statistical Guidance report 92-54. It was agreed in the resolution of comments on the soil background report that the statistical analyses of the background data set would follow the MTCA guidance. We assume that the statistical analyses of ground water data will also follow the MTCA guidance and that Section 5.4, table 5-9, and Appendix B are all being modified appropriately.

3) The references to section numbers are not always clear or apparently consistent; are these section numbers from the main body of the report (and what version of the report) or from this appendix? Upon initial review of the appendix it appeared that it was written from a newer working version of the document. On December 3, we contacted the WHC engineer in charge of the document (Scott Petersen) and were assured that there is not a newer working version of the body of the document. We have therefore taken the effort to identify the numerous inconsistent references with the assumption that they are in fact in error, and not an artifact of inconsistent versions.

## SPECIFIC COMMENTS

- 1) Section 1.0, line 14, page D-1:  
Comment - A figure 4-1 is referred to; this figure does not appear in the 4/92 version of the report.
- 2) Section 1.0, line 21, page D-1:  
Comment - The table referred to (5-2) is Table 5-5 in 4/92 version of report.
- 3) Section 1.0, line 1, page D-2:  
Comment - Where are the "calculated ages shown above"? (Table 5-2?/5-5?).
- 4) Section 2.0, line 8, page D-3:  
Comment - The table referred to (4.12B) is not in the 4/92 version of the report.
- 5) Section 2.0, line 12, page D-3:  
Comment - Should 915 meters be 15 meters?
- 6) Section 2.0, line 9, page D-4:  
Comment - The figure referred to (4.1.3) is not in the 4/92 version of the report.
- 7) Section 3.0, line 10, page D-5:  
Comment - The average recharge values for the two zones from the Bauer and Vaccaro report that cover the Hanford Site (from their table 5), are 0.74 and 0.96 cm/yr.
- 8) Section 3.0, line 26, page D-5:  
Comment - The following should be added to the end of the sentence "...except in recharge areas (i.e., Cold and Dry Creek infiltration areas)."
- 9) Section 3.0, line 38, page D-5:  
Comment - Table 3-2 should be table 3-1.
- 10) Section 3.0, line 38, page D-5:  
Comment - Should the reference to the Morton Model be Wallace (1978)?
- 11) Section 3.0, line 42, page D-5:  
Comment - Should "...simulations..." be "...values..."?
- 12) Section 3.0, line 45, page D-5:  
Comment - See comment on Section 3.0, line 10, page D-5.
- 13) Section 3.0, line 47, page D-5:  
Comment - Should the reference to Morton 1975 be Smoot 1989?
- 14) Section 3.0, line 51, page D-5:  
Comment - Table 3-2 should be table 3-1.

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- 15) Section 3.0, line 51, page D-5:  
Comment - The models give average values, not maximum values.
- 16) Section 3.0, line 8, page D-6:  
Comment - The Gee and Hillel reference is given as 1989 in the reference list.
- 17) Section 4.1, line 33, page D-8:  
Comment - Should table 5-2 be table 5-5?
- 18) Section 4.2, lines 40-45, page D-8:  
Comment - There appears to be substantial confusion over what was in the Hearn et. al. report. Has this report been confused with the Bortelson and Cox (1986) report?  
- Hearn rept.;  
- 195 samples  
- all of Columbia Plateau from Hanford to Spokane  
- although shallower than Hanford, perhaps longer flow paths  
- 13 from Saddle Mountains, 6 from Saddle Mountain-Wanapum, 83 from Wanapum, 71 from Wanapum-Grande Ronde, and 22 Grande Ronde  
- Bortleson rept;  
- 93 samples from Wanapum-Grande Ronde  
- 87 of these in area to NE of Hanford
- 19) Section 4.3, line 28, page D-9:  
Comment - Does this refer to the earlier mentioned data (Hearn/Bortelson)? Most of the wells in the Bortelson report were greater than 500 feet deep (33 were >1000); only 5 were less than 250 feet deep.
- 20) Section 5.0, line 12, page D-11:  
Comment - "...relevance of on ..." should be "...relevance of..."
- 21) Section 5.0, line 17, page D-11:  
Comment - "...composition due to..." should be "...due to..."
- 22) Section 5.2, line 36, page D-14:  
Comment - Sections 5.3.1 and 5.3.2 should be 5.2.1 and 5.2.2.
- 23) Section 5.2.1, line 17, page D-15:  
Comment - Section 5.3.2.1 should be 5.2.2.1.

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- 24) Section 5.2.2, line 37, page D-15:  
Comment - The tests were performed at 23 degrees C. Most shallow aquifer temperatures are probably about 10 degrees. The difference in temperature should affect the kinetics of the chemical reactions and solubility of the individual constituents. Can you describe the significance of a difference of 13°C on these chemical reactions?
- 25) Section 5.2.2.1.2, line 8, page D-17:  
Comment - Table 5-7 should be table 5-6.
- 26) Section 5.2.2.1.3, line 41, page D-17:  
Comment - Table 5-8 should be 5-7.
- 27) Section 5.2.2.2, line 52, page D-17:  
Comment - The reference (EPA, 1990) is not in the reference list.
- 28) Section 5.2.3.2, line 8, page D-21:  
Comment - It is stated that all constituents show a rapid increase. For Basalt(air); Al, Fe, K, F, PO<sub>4</sub>, and NO<sub>3</sub> all decrease. For Ringold(air); Fe and PO<sub>4</sub> decrease and Al, K, Si, and F show mixed responses.
- 29) Section 5.2.3.2, line 14, page D-21:  
Comment - It is stated that concentrations were largely constant. For Ringold(air); Si and Cl decrease. For Ringold(nitrogen) and Basalt(air and nitrogen); Si decreases and Cl increases from 32 to 64 to 128 days.
- 30) Section 5.2.3.2, line 17, page D-21:  
Comment - Ca, Mg, and Na are given as examples of constituents which show slightly increasing concentrations with time after the first 24 hours. This is true of Na, but not Ca or Mg.
- 31) Section 5.2.3.2, line 25, page D-21:  
Comment - Also true for TOC?
- 32) Section 5.2.3.2, line 27, page D-21:  
Comment - "Strongly..." should be "Strong..."
- 33) Section 5.2.3.2, line 32, page D-21:  
Comment - Cl:F ratios of 1.2 to over 5 are indicated. However, on line 46, page D-20, ratios of "up to 12" are indicated.
- 34) Section 5.2.3.3, line 45, page D-21:  
Comment - It is stated that leachate concentrations are 10-100 times larger than those of subsequent leachate. However, the data for basalt show mostly 1.5 to 2.5 times differences.

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- 35) Section 5.2.3.3, line 20, page D-22:  
Comment - Cl:F mass ratios are given as being from 1 to 2. The range appears to be much greater, with a large number of samples less than 1.
- 36) Section 5.2.3.5, line 38, page D-22:  
Comment - "...DIW a ..." should be "...DIW in a..."
- 37) Section 5.2.4, line 41, page D-23:  
Comment - "...test and the test result represents." should be "...tests and the test results represent."
- 38) Section 5.2.4.1.2, line 10, page D-25:  
Comment - What does "compositions groundwater" mean?
- 39) Section 5.2.4.1.2, line 38, page D-25:  
Comment - Section 5.3.4.1.3 should be 5.2.4.1.3.
- 40) Section 5.2.4.1.3, line 9, page D-26:  
Comment - "...and natural..." should be "...natural..."
- 41) Section 5.2.4.2, line 14, page D-26:  
Comment - "...system test..." should be "...system..."
- 42) Section 5.2.4.2, line 30, page D-26:  
Comment - This section has the same number as the previous section.
- 43) Section 5.2.4.2, line 33, page D-26:  
Comment - "...system test..." should be "...system tests..."
- 44) Section 5.2.4.2, line 33, page D-26:  
Comment - The reference to Table 5-9 appears to be wrong. Table 5-9 shows only test results, not groundwater. Make comparison to figures 5-8/5-9?
- 45) Section 5.2.4.2, line 41, page D-26:  
Comment - "...only Na..." should be "...Na..."
- 46) Section 5.2.5, line 7, page D-28:  
Comment - List the "certain trace elements".
- 47) Section 5.2.5, line 14, page D-28:  
Comment - Are total dissolved solids presented in this report?
- 48) Section 5.2.5, line 15, page D-28:  
Comment - The "first week" of reaction is referenced. There were no 7-day tests.

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49) Section 6:

Deficiency/Recommendation - We question the conceptual hydrologic model upon which the chloride mass balance and isotopic evaluation are based. In section 6.2 it is stated that "spring water is the primary source of upgradient recharge to most of the unconfined aquifer, and is influenced by evaporation when it flows as surface water. Thus spring water is the most appropriate parental source composition for use in mass balance and isotopic evaluations." In section 6.4.1.2, it is stated that "Locally spring waters form streams (i.e., Dry Creek and Cold Creek) that flow some distance across the Pasco Basin before losing their water to evaporation and infiltration. Spring water that has undergone secondary evaporation in these streams is the most likely source for high chloride ground water in the unconfined aquifer."

We question this conceptual model for two reasons. Firstly, spring flow in Dry Creek, measured at Rattlesnake Springs, is relatively constant (in the 1991 water year, monthly discharge varied between 0.38 and 0.66 cfs and averaged 0.48 cfs) meaning that about half the annual discharge would occur during the late fall, winter, and early spring (approximately mid-October to mid-March) at which time very little evaporation would be likely to occur. Thus, nearly half of the spring water available for infiltration is probably only marginally affected by "secondary evaporation". Secondly, and most importantly, the conceptual model does not account for infiltration of water from large storm events discharging from the Cold and Dry Creek watersheds. Large runoff events in Cold and Dry Creeks normally occur as the result of snowmelt or rain-on-snow events and, although they do not occur every year, when they do occur they can yield a large volume of water. For instance, a single event with an area-weighted discharge of only 0.25 inches from the combined 160 square mile watersheds of Cold and Dry Creeks would yield  $92.9 \times 10^6$  cubic feet of water, or about six times the total normal discharge of Rattlesnake Springs at Dry Creek. These events occur in the winter or early spring during which time very little evaporative loss from the surface water would be expected to occur. After infiltrating into the stream channel and surrounding soil, some of this storm water will be subjected to evapotranspiration, however, once again, because these events occur during the winter, these losses are expected to be minor.

We suggest that these aspects of the hydrologic conceptual model be considered and incorporated into the analysis of the chloride mass balance and, in particular, the isotopic evaluation.

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- 50) Section 6.2, line 13, page D-35:  
Comment - The Craig (1961) reference is not in the reference list.
- 51) Section 6.2, lines 19-20, page D-35:  
Comment - It is stated that the concentration of Cl increases systematically with distance from initial source. This is not true according to figure 6-1 which shows the regional pattern of chloride in rainwater. The chloride concentration actually decreases with distance from the ocean.
- 52) Section 6.3, line 4, page D-36:  
Comment - An additional source of Cl has also been suggested; upflow of deep Cl-waters in the basalts (see new paper in press by Johnson, Graham, and Reidel).
- 53) Section 6.3, line 6, page D-36:  
Comment - "...term of..." should be "...terms of..."
- 54) Section 6.4.1, lines 30-31, page D-36:  
Comment - The reference to Section 4.1.4 appears to be in error.
- 55) Section 6.4.1, line 48, page D-36:  
Comment - What does "preceding infiltration" mean?
- 56) Section 6.4.1, line 17, page D-38:  
Comment - The reference to Section 4.1.1 appears to be in error.
- 57) Section 6.4.1.2, line 31, page D-38:  
Comment - "...precipitation, having..." should be "...precipitation which has..."
- 58) Section 6.4.1.3, line 39, page D-38:  
Comment - The range of deposition rate should be indicated as being for the Hanford Site.
- 59) Section 6.4.1.3.1, line 5, page D-39:  
Comment - "...average..." should be "...averages...";  
"...does..." should be "...do..."
- 60) Section 6.4.1.3.1, line 11, page D-39:  
Comment - "...indicates..." should be "...indicate..."
- 61) Section 6.4.1.3.1, line 19, page D-39:  
Comment - "...waters plotted..." should be "...waters are plotted..."
- 62) Section 6.4.1.3.1, line 4, page D-40:  
Comment - The reference to Section 4.1.1 appears to be in error.

- 63) Section 6.4.1.3.2, line 26, page D-40:  
Comment - Well 699-19-88 is not shown on the map. Also, this well is probably nearer to the end of the Dry Creek recharge area, not at the source.
- 64) Section 6.4.1.3.2, line 26, page D-40:  
Comment - "Top-of-water-..." should be "Water-..."
- 65) Section 6.4.1.3.2, line 41, page D-40:  
Comment - "...exception of fluoride and sulfate..." should be "...exception of manganese, barium, and sulfate..."
- 66) Section 6.4.1.3.2, line 44, page D-40:  
Comment - "...is fortuitous." should be "...may be fortuitous."
- 67) Section 6.4.1.3.4, line 43, page D-43:  
Comment - The text describes a "recharge area near Spokane into the Pasco Basin". It should be kept in mind that the recharge to the deeper basalts (Grand Ronde) is not limited to the outcrop areas of these basalts. There is downward leakage through the entire sequence of basalt units over most of the Columbia Plateau between Spokane and the Pasco Basin.
- 68) Section 6.4.1.3.5, line 5, page D-43:  
Comment - "...test..." should be "...tests..."
- 69) Section 6.4.1.3.6, lines 39-41, page D-43:  
Comment - What is the basis for the statement that the Grande Ronde is much tighter than the shallower basalts? Hydraulic-conductivity data for the basalt units in the Columbia Plateau (Hansen et. al., 1992; USGS WRI-4187) indicate median values of 2.4 ft/d for the shallow basalts (Saddle Mountains) and 4.9 ft/d for the Grande Ronde.
- 70) Section 6.4.2, line 5, page D-44:  
Comment - "...use..." should be "...uses..."
- 71) Section 6.4.2.1, line 8, page D-44:  
Comment - "...aspect..." should be "...aspects..."
- 72) Section 6.4.2.1, line 21, page D-44:  
Comment - What is meant by "low" temperatures? The tests were conducted at 23 degrees C, which is probably greater than that occurring in most shallow groundwater.
- 73) Section 6.4.2.1, line 28, page D-44:  
Comment - "...chloride, in..." should be "...chloride in..."
- 74) Section 6.4.2.1, line 29, page D-44:  
Comment - "...amount..." should be "...amounts..."

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- 75) Section 6.4.2.2, line 19, page D-45:  
Comment - The range of -140 to -120 appears to be in error; there are two values that appear to be outside the range (about -108 and -112).
- 76) Section 6.4.2.2, line 20, page D-45:  
Comment - The range of -130 to -110 appears to be in error; there is one value at --107.
- 77) Section 6.4.2.2, line 30, page D-45:  
Comment - What does "these water" refer to; meteoric or river?
- 78) Section 6.4.2.2, line 48, page D-45:  
Comment - "...respect..." should be "...respect to..."
- 79) Section 6.4.2.2.2, line 43, page D-46:  
Comment - Define "RS" and "RL" (or refer back to earlier definition).
- 80) Section 6.4.2.2.2, line 47, page D-46:  
Comment - "...percenet..." should be "...percent..."
- 81) Section 7.0, page D-49:  
Comment - Apparently this list contains only those references which are quoted in Appendix D but do not appear in main body of report?
- 82) Section 7.0, line 4, page D-49:  
Comment - "...Helgeson,..." should be "...Helgeson, 1982..."
- 83) Table 3-1, page D-T1:  
Comment - The recharge range shown for Bauer and Vaccaro should be 0.74 to 0.96. These values are the averages for their zones which include the Hanford Site. The lowest range that they show is 0-0.25 and the highest range is 2.5-5.1 cm/yr.
- 84) Table 3-2, page D-T2:  
Comment - Rockhold et. al. 1988, Campbell et.al. 1990, T.L.Jones 1989, and Stone et. al. 1983 are not in the reference list.
- 85) Table 5-1, page D-T3.1:  
Comment - What does the less than sign refer to; less than detection limit?
- 86) Table 5-4, page D-T6:  
Comment - "5 daus" should be "5 days" (two occurrences)
- 87) Figure 3-1, page D-F1:  
Comment - As shown, the figure did not come directly from Bauer and Vaccaro 1990.

- 88) Figure 6-1, page D-F11:  
Comment - Eriksson 1960 is not in the reference list.

There appears to be some confusion between the easternmost Cl line and the line linking the label (Columbia River Drainage Basin Boundary) with the boundary.

- 89) Figure 6-3, page D-F13:  
Comment - How was the outline for the "Field" drawn? It does not appear to match the data in figure 6-2.

- 90) Figure 6-5, page D-F15:  
Comment - How was the outline for the "Field" drawn? It does not appear to match the data in figure 6-4 (e.g., 6-4 shows only 1 Cl >15, but "field" on 6-5 shows two inflection points >15).

The figure shows a "U" value ~5.0 while table 6-3 has 5.468?

The figure shows an "S" value of about 5.5 while table 6-3 has 6.089?

- 91) Figures 6-7 and 6-11, pages D-F17 and D-F20:  
Comment - Define "Bounding Conditions 1 and 2".

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9/29/2009