TETRA TECH COMMENTS ON THE ROCKY FLATS PLANT
REMEDIAL INVESTIGATION REPORT
GOLDEN, COLORADO
FOR THE U.S. ENVIRONMENTAL PROTECTION AGENCY REGION VIII
11 February 1988

GENERAL SUMMARY

Volumes I-IV of the Remedial Investigation Report for the 903 pad, mound, and east trenches area at the Rocky Flats Plant in Golden, CO were reviewed for compliance with applicable federal regulations. Specifically, 40 CFR Part 300, the National Contingency Plan for Oil and Hazardous Materials Response (U.S. EPA 1985), was used as the basis for the review. The requirements for conducting a remedial investigation (RI) are described in 40 CFR Part 300, Subpart F, Sections 300.68(d) and (e). In addition, guidance for conducting an RI under CERCLA is contained in U.S. EPA (1987a).

The purpose of an RI is to collect sufficient data for the evaluation of appropriate remedial measures and treatment technologies at a hazardous waste site. According to 40 CFR Part 300, Section 300 68(d) (U.S. EPA 1985), determination of the nature and extent of a threat presented by the release of hazardous substances is a mandatory part of an RI.

The Rocky Flats Plant RI is remiss in adequately assessing the nature and extent of site contamination For example, the RI presents copious raw data, but a conceptual model of the groundwater flow system is absent. This model would serve as a valuable source of information for the feasibility study. Other areas in which the RI is deficient include the determination of background contaminant levels for all matrices, source characterization, evaluation of the offsite migration of contaminants, the evaluation of public health and environmental risks posed by the three sites There is no estimate of the population at risk from exposure to groundwater, which could be resolved by a field survey of the domestic water supply wells in the vicinity of the facility. The RI also fails to address future population changes and how those changes may impact the groundwater flow system.

In 40 CFR Part 300, Section 300.68(e)(2)(xiii) (U.S. EPA 1985) it is indicated that the extent to which contaminant levels exceed relevant and appropriate federal requirements (or other federal advisories and guidance and state standards) shall be assessed. The Rocky Flats Plant RI contains no discussion of these standards. A review of applicable standards and a comparison with observed levels of contaminants at the facility would provide information for determining the extent that contaminants exceed the standards.

The RI contains both site-specific, and general or regional information. The site-specific information is not adequately used to qualify the regional information. This qualification is necessary to define a local context for the site to allow an accurate evaluation of conditions at the site

SITE CHARACTERIZATION

Determination of Background Contaminant Levels

In general, the approach used in the RI to determine background contaminant levels for all environmental media is questionable. Accurate determination of background levels of the contaminants of concern is crucial to defining the extent of contamination, establishing cleanup criteria during the feasibility study, and performing a risk assessment at the site. Background levels should be established for all media that reflect conditions as they exist in areas totally unaffected by activities at the site. As indicated below, the RI does not accomplish this goal.

Groundwater--

v III p 5-20; v III p 5-20

Determination of background water quality is inadequate for several reasons and should be reevaluated. The background wells in the alluvial and bedrock aquifers have not been show to be hydraulically upgradient from the study area, and are described as potentially affected by nearby waste management areas, including the West Spray Field and Ash Pits The RI includes the statement that "concentration ranges for each analyte ar examined for each background well to qualitatively assess whether these SWMUs (solid waste management units) are impacting groundwater quality." The criteria for determining if the SWMUs have affected groundwater quality are not defined.

v III p 5-20

Also, background should be determined quantitatively, not qualitatively. The RI never explicitly states how background levels are established. In addition, the report often refers to "natural variations" in analyte concentrations but does not provide data documenting these variations. It does not appear possible to discern "natural variation" from possible contamination by facility waste management activities using data presented in the RI.

v III p 5-29

The bedrock background wells are reported to be completed in a different geologic unit (the Laramie Formation) than the bedrock wells in the study area, which are completed in the Arapahoe Formation. Background wells should be completed in the same formation, as geochemical differences may exist between the two units.

v III p 5-21; v III p 5-24; check

Other major shortcomings in the background water quality determination concern the analytical parameters selected. Table 5-4 lists the analyses performed on groundwater and surface water samples. Table 5-5 describes background alluvial groundwater quality. Several discrepancies are apparent. Variables listed in Table 5-4 that are not present in Table 5-5 include pH, specific conductance, chromium (hexavalent), iron, lithium, gross alpha, gross beta, uranium 233,

strontium 90, cesium 137, and tritium. Conversely, barium, cesium, cobalt, molybdenum, and vanadium data are presented in Table 5-5 but are not listed in Table 5-4 The same discrepancies exist between
v III
P 5-30
Table 5-4 and Table 5-6 (background bedrock groundwater quality) These inconsistencies must be addressed in the next draft of the RI.

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p. 5-19
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clarify

It is not clear what (if any) organic variables were analyzed in background samples. In the report, it is stated that the "presence of HSL organics ... necessarily implies contamination." Does this mean that background samples were not analyzed for HSL organics? Background samples should be analyzed for a full range of organic compounds to ensure that the water is not affected by other contaminant sources. Table 5-4 includes only nine HSL volatiles (PCE, TCE, 1,1-DCE, 1,2-DCA, t-1,2-DCE, 1,1,1-TCA, 1,1,2-TCA, CCl_4, and CCl_3) that were analyzed for in samples. There are several problems with this. First, the data presented in Appendix F show several contaminants (methylene chloride, acetone, styrene, 2-butanone) at low levels. Apparently these variables were included in the analytical scheme, but were not listed in Table 5-4. If this is true for other contaminants, it should be explained in the report. The data tables in Appendix F that present the analytical results list only the organic compounds that were detected. Because of this, it is not possible to determine the variables analyzed for any given sample. Also, it is not clear whether the contaminants detected in background wells are attributable to lab contamination or to waste disposal practices This fact alone should invalidate the selection of some of the wells as representing background. Second, there is no rationale for the variable list being limited to the nine (and possibly more) chlorinated solvents listed above. It is not clear that the sources at this site have been sufficiently characterized to warrant this limitation. Third, it is not stated whether samples were ever analyzed for HSL semi-volatiles (base/neutral/acid extractable organic compounds and pesticides/PCBs). If not, some rationale must be provided as to why these compounds have been eliminated In addition, it is recommended that a rigorous statistical evaluation of all background data be performed, including a discussion of the applicability of the statistical methods employed. Until this is done, an accurate interpretation of the data is not possible

Surface Water--

The determination of background surface water quality presented in the RI report is inadequate for the following reasons:

V IV p 6-9

- In part, the assessment is based on background groundwater quality data that is not valid for reasons previously discussed.

V.IV p 6-4

- Surface water samples were not filtered, and there is the possibility that contaminants transported by air to the assumed "background" sampling locations and resuspended in surface water raised contaminant levels above actual background levels.

v IV p 6-9

- In the RI, the maximum value found in either background surface water or groundwater samples is used as background criteria. This approach is completely unjustified and may produce background levels significantly higher than actual levels.

v IV p 6-4

- It appears that background surface water data was obtained from a single sampling event (24 July 1987). This does not allow for the Ostudy of seasonal variability, or variations due to surface runoff generated during storm events. Seasonal variations and storm events may be significant at this site due to the reported prevalence of surface soil contamination

For these reasons, determination of background surface water quality should be reevaluated

Surface Soils--

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p 4-30

In the report it is stated that "a one-time sampling of a plot in the west buffer zone to a depth of one foot cannot be considered a complete characterization of background alluvial...materials." Because there has been documented airborne transport of contaminants at the site, and 28 percent of the winds are easterly, ambient surface soil conditions must be determined at an offsite location that is clearly and demonstrably unaffected by onsite activities. Of particular concern in surface soil media is the establishment of accurate background levels for radionuclides.

Geology and Groundwater Hydrology

Determination of the extent of contamination in the groundwater flow system is mandated by 40 CFR Part 300, Section 300.68(d) (U.S. EPA 1985). Hydrogeological factors to be considered in scoping response actions are contained in 40 CFR Part 300, Section 300.68(e)(2) (U.S. EPA 1985), and include soil permeability, depth to the saturated zone, and other hydrogeologic conditions. These factors include general geologic and hydrologic data that, when integrated, provide the information needed to develop a conceptual model of the groundwater flow system.

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p. 9-10

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9-10, 9-11

The RI fails by its own admission to determine the extent of contamination within the groundwater flow system The RI includes the statement, "The downgradient extent of contamination in the ground water of these bedrock sandstones is unknown." This lack of definition of the extent of contamination is also true for the alluvial aquifer. The RI provides no definitive estimate of the lateral or vertical extent of contaminants in the various parts of the groundwater flow system. Unsupported assumptions are used to provide rough estimates of the extent of contamination, or to dismiss offsite transport of contaminants altogether.

Hydrogeological factors that contribute to a conceptual model of the groundwater flow system are provided in U.S. EPA (1987a). The significance of a particular factor is site-specific. The draft RI presents many of these factors, but fails to combine them into a cohesive explanation of the groundwater flow system. The reader must decipher the explanation, or, in some cases, attempt to interpret the information that is presented. The major factors that are omitted or insufficiently detailed in the RI include the following points:

- Onsite groundwater flow direction(s)
- Transport characteristics (e.g., retardation, sorption)
- Potentiometric surfaces
- Geologic structure
- Porosity and effective porosity
- Areas of groundwater discharge
- Homogeneity and isotropy of each aquifer
- Seasonal flow/event flow.

Detailed information gathered during field investigations has been used to develop maps of the surficial geology (Plate 5-1) and the bedrock surface underlying the unconsolidated deposits (Plate 5-2) This detailed information is not used to develop an accurate conceptual model of groundwater movement for the site Generalizations about the direction of alluvial aquifer groundwater movement, which is controlled by the underlying bedrock surface topography, are accurate in a regional sense but lead to gross misinterpretations when used to define upgradient and downgradient monitoring wells relative to waste disposal areas within the facility boundary. Generalizations on a regional

v III
Section 5

scale do not apply to conditions that exist on the facility scale Site-specific data exists to accurately define the bedrock surface and thereby characterize alluvial aquifer groundwater flow.

The fate and transport of contaminants through the groundwater flow system is poorly defined at best. The groundwater potentiometric
v.III surface in the alluvium is presented on Plate 5-7, which indicates
v.III p. 5-10 groundwater flow in a radial pattern, contradicting statements made on page 5-10 that ground-water flow in the Rocky Flats Alluvium is generally from west to east. The available data should be reevaluated to determine onsite flow patterns in the alluvial aquifer. In addition the downward directed vertical movement of groundwater is not mentioned in this discussion. This component of groundwater flow affects the fate of contaminants in the alluvial aquifer and should be included in
v III p. 5-14 this discussion. The vertical component of flow is discussed relative to the bedrock aquifer.

v.III p. 5-17 No potentiometric surface data or plots are presented for the bedrock aquifer. Water level data from appropriate bedrock wells should be compiled to produce such maps. These maps are the basis for the determination of horizontal hydraulic gradients in the bedrock
v III pl. 5-3, 5-4, 5-5, 5-6 aquifer One-dimensional representations of the potentiometric surface are presented on geologic cross-sections, but these are inadequate for purposes of determining flow direction in the bedrock aquifer. Time-variant potentiometric surface maps should be provided for both the alluvial aquifer and the bedrock aquifer to examine seasonal, annual, and rainfall-event related changes in flow patterns.

v III p 5-13 p 5-19 The effective porosity value (0.1) used in the computation of flow velocities in the bedrock and alluvial aquifers is provided with no justification for its selection. Typical values for porosity presented in Freeze and Cherry (1979) range from 0.25 to 0.40 for gravel, 0 25 to 0 50 for sand, 0.35 to 0.50 for silt, 0.40 to 0.70 for clay, and 0 05 to 0.30 for sandstone. Effective porosity is generally less than actual porosity for sandstone, whereas the value for unconsolidated materials is close to the actual porosity Larger values of porosity result in reduced estimates of travel time The basis for the assumed value should be provided

The text contains no discussion of the transport properties of the contaminants relative to the medium through which they move (i.e , alluvium, sandstone, claystone, etc.). A transport property that has been used at other U.S. Department of Energy (DOE) facilities to study and predict the transport of radionuclides in aquifer systems is the retardation factor, which incorporates adsorptive and other chemical processes (distribution coefficient), and the bulk mass density and porosity of the porous media (U.S. DOE 1986). Radioactive decay is another factor to be considered in defining radionuclide transport in porous media (Freeze and Cherry 1979). A discussion of the transport of nonreactive constituents will require an understanding of the coefficient of hydrodynamic dispersion (including dispersivity and the coefficient of molecular diffusion) and of groundwater velocities, which are discussed in the RI for horizontal components of groundwater flow only. Such information is important in determining whether future migration would be expected to pose a threat to public health or the environment, and if so, to what degree. Data concerning these properties can be obtained from laboratory bench tests on geologic cores and through field testing.

Estimates of the parameters defining dispersivity and retardation factors are scale dependent, and considerable uncertainty is involved in extrapolating bench-scale test results to field situations (Freeze and Cherry 1979). The RI should evaluate the effect of scale on these parameters for the Rocky Flats site. The applicability of the proposed test methods to site conditions and to data needs should also be evaluated in the RI. Examples of field test methods that may be considered include single-well withdrawal/injection tests, natural gradient tracer tests, two-well recirculating withdrawal/injection tests, and two-well pulse tests The existing monitoring well network could be used for these tests Conventional column tests or batch tests may be considered for laboratory testing Another approach for obtaining information is the review of investigations conducted at related sites

Draft guidance for performance of the hydrogeologic phase of the RI has been provided in U S. EPA (1987a). This guidance recommends a number of items necessary to understand the hydrogeology of a site. These include the nature of confining layers, the areal extent of water bearing units and aquifers, the nature of each aquifer, the aquifer's flow volumes and boundary conditions, and the location of recharge and discharge areas.

v.III p. 5-6 Geologic information contained in the text indicates the presence of a claystone in the upper portion of the Arapahoe Formation. This claystone is a potential confining layer between the alluvial and bedrock aquifers. This layer may impede the vertical migration of contaminants and could possibly be used as part of a remedial system. The hydrogeologic character, significance, and continuity of this claystone should be evaluated in the RI. Relevant information concerning this layer that may have been presented in other documents should be summarized and incorporated in the RI. The potential effect of the claystone on groundwater flow should be discussed in the review of groundwater flow directions. (v III p 5-17)

v III p. 5-1 The areal extent of each of the aquifers is not well defined in the hydrogeology section, especially for offsite areas. Geologic information combined with water level data can be used to estimate the areal extent of each of the aquifers. The nature (unconfined or confined) of the bedrock aquifer is only briefly discussed. This discussion should be expanded to include data from all monitoring wells completed in this aquifer (v III p 5-17) Aquifer flow volumes and volumes of contaminated groundwater are not presented in the RI. Some data used to determine flow volume in the alluvial aquifer (e.g., average flow velocity) are included in the RI. However, the saturated thickness and areal extent of the aquifer requires additional definition. Volumes of contaminated (v III p 5-13) groundwater can be estimated using maps illustrating the extent of contamination, porosity, and the geometry of the saturated materials

Geologic structures (including faults, fractures, and joints) are an important part of the determination of aquifer flow boundaries and conditions. The effect of geologic structures on the groundwater flow system is not discussed in the RI. Such a discussion would include the impact of geologic structures on the groundwater flow system as observed using information from aquifer tests, flow nets, and aerial photographs. No discussion of discharge points for the bedrock and alluvial aquifers is presented. The information presented in the RI is not sufficient to determine locations at which contaminants may be expected to exit the aquifer(s) and enter surface water systems. Water level data, water chemistry data, and seep information can be integrated to better define areas of potential or known discharge.

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Surface Water

Surface water drainages at the plant collect runoff from the entire facility, including the three areas of concern. Runoff holding ponds provide a recharge source to the alluvial aquifer because they are unlined. Water from one of the holding ponds (B-3) is sprayed on the ground surface in the vicinity of the east trenches, one of the three areas of concern. This provides another source of recharge to the alluvial aquifer, and may be enhancing contaminant loading to that aquifer.

v IV
p 6-2

All surface water bodies at the facility should have been included in the RI sampling effort to characterize contaminant loading to the alluvial aquifer. Of particular importance is the water and sediment quality in and downgradient of the B and C series ponds, which ultimately discharge to recreation areas and municipal water supplies The B and C series ponds have historically been used for waste disposal. The B series ponds include surface water impoundments that contain elevated concentrations of radionuclides and volatile organic compounds.

v IV
p 6-2

v IV
p 6-19 to
6-23

Some of these ponds have been used for waste disposal and should be evaluated as potential contaminant sources for surface water and groundwater contamination

v.IV p. 6-3 The statement that Woman Creek is isolated from surface water runoff from the facility is grossly misleading, as the south interceptor ditch (which collects facility runoff) discharges to Pond C-2, which in turn discharges to Woman Creek. (v.IV p 6-2) No documented attempt is made to quantify surface water flow in the RI aside from limited visual estimations. Flow determinations should be made using a calibrated field instrument, and should include data characterizing seasonal variations and rainfall-event induced flow. The extent and nature of interaction between the pond systems and the underlying alluvial aquifer is inadequately addressed in the RI; although it is stated that surface water flow is largely determined by this interaction (v IV p. 6-3, 6-4)

Surface water samples collected at the site include samples from seeps (representing discharge from the alluvial aquifer), surface water drainages, and impoundments To assure a conservative approach to site characterization, an analyte concentration should be flagged as possibly indicating contamination if it is greater than the minimum value specified for background surface water, not by comparison to the maximum values as presented in the RI. (v IV p. 6-9) The approach used in the RI excludes potentially contaminated surface waters from further study. Significant concentrations of radionuclides and volatile organic compounds are evident in many of the seep samples. (v IV p 6-9 to 6-12) The radionuclide concentrations in seep samples presented in the RI are dismissed as surface soil (airborne) cross contamination (v IV p 6-12) This is unjustified because samples of adjacent surface soils and of filtered seep waters were not collected and analyzed that would allow this conclusion to be made. Contaminant loading of nearby surface waters was not estimated using the values obtained, even though stream sediment samples down-gradient of the facility contain significant levels of radionuclides (v IV p 6-25, 6-26) The B series ponds were not sampled for the RI, and have improperly been assigned as low priority sites (v.IV p 6-1) Justification for this decision is not provided in the RI, this decision should not be made prior to source characterization. Potential contaminant loading of the alluvial aquifer by the B series ponds should be evaluated.

v.IV Section 6 — Contaminant levels in surface water samples are repeatedly referred to as "at or near detection limits," with the detection limits unstated and unavailable. This approach provides no information concerning actual measured concentrations of the contaminants in question, and may be misleading, depending on data and sample quality. Bottom sediment samples have not been collected and analyzed from many of the surface water impoundments that have historically been used for waste disposal. It is assumed that these ponds are unlined, with a distinct potential for recharge to the shallow aquifer, in addition to their documented discharge to adjacent surface drainages. (v.IV p. 6-2, 6-3) All onsite surface waters need to be systematically evaluated to determine the role they play in contaminant loading to the alluvial aquifer and to surface drainages, which ultimately enter reservoirs that serve as public drinking water supplies. (v.IV p. 6-2, 6-3) Analyses of stream sediment samples collected at the eastern facility boundary document the likelihood of offsite migration of plutonium and americium by bedload transport. (v.IV p. 6-25, 6-26)

Surface Soils and Subsoils

v I p 2-28 — The data concerning surface soil samples are enigmatic. Information presented on page 2-28 suggests that surface soil samples were not collected for the RI. (v II Section 4) Surface soil results are presented from borehole locations, but the depth interval over which the samples were collected is not mentioned. If the surface soil samples presented in the RI were composited over more than the upper 6 in of soil, additional sampling from the 0 to 6 inch interval should be undertaken to define the nature and concentration of contaminants available for windborne dispersion

v.II P. 4-3 to 4-63 — The surface soil data presented in the RI indicate that significant surface soil contamination (relative to background levels) by arsenic.

barium, cadmium, chromium, and mercury exists at the site. Many of the stated concentrations far exceed background levels but are dismissed as being indicative of natural soil variations with absolutely no justification (v II e g , p 4-42). The high barium concentration (1,899 mg/kg) noted for Sample BH2587009D should be followed by additional sampling to determine the extent of barium contamination, rather than dismissed as being insignificant (v.II p. 4-42). Additional metals, including strontium, cesium, vanadium, lithium, and other metals detected in other matrices, and used or disposed of at the facility should be included in analyses of both surface soils and subsoils to characterize the extent and nature of contamination at the site.

v.II p. 4-45, 4,46
The RI concludes that "solvent contamination of soils in this area (the 903 pad and lip area) is not extensive and possibly nonexistent." This statement is misleading because soil gas analyses in the vicinity of the area indicate high solvent levels. Groundwater here has been found to contain significant levels of acetone, TCE, PCE, CCl_4, and phthalates (v.III p. 3-32 to 3-37). Of overriding importance to the stated levels of contamination in soils is the absence of sampling directly from the waste storage areas being characterized. All analytical results for soils presented for the 903 pad and mound area are from the vicinity of the storage areas, not directly from the storage areas. This is a major deficiency in the RI, and would be expected to result in the underestimation of contaminant levels, and in excessive speculation concerning the presence and number of known contaminants in surface soils and subsoils (v II Section 4).

An additional factor reducing the levels of contamination stated in the RI from the probable true concentrations for subsoil samples is the use of samples composited over excessively large depth intervals As mentioned previously, surface soil sample descriptions and results do not include the depth interval over which the samples were collected The stated depth interval for the uppermost subsoil samples collected in boreholes ranges from 0-8 to 0-12 ft below ground surface (v.II Section 4). Samples composited over such large intervals can result in underestimates of contaminant concentrations, particularly if the contaminants are depth stratified or the interval includes fill material. Such samples may dilute contaminants to below detection limits that might otherwise be observed at moderate to high concentrations for samples collected from specific depth horizons or associated with specific lithologies

The use of excessively large composite intervals and the failure to sample within the storage areas severely compromises the conclusions presented for both surface soils and subsoils in the RI, and results in a misleading and inadequate characterization of the contaminants present, their location, and their actual concentrations. Despite these shortcomings, plutonium, americium, and organics are present in high concentrations in the soil analytical results presented in the RI.

v II
Section 4

SOURCE CHARACTERIZATION

Sampling Approach

At this point in the Rocky Flats RI process, known sources of contamination have not been adequately characterized to support a comprehensive feasibility study to evaluate potential remedial actions. Source characterization cannot be accomplished by sampling adjacent to, or in the vicinity of, known contaminant sources Subsequent studies will require detailed information in order to evaluate treatment and/or disposal options, including the nature, concentration, and vertical and lateral extent of contamination in known disposal areas and in suspect areas as defined using geophysical survey methods In order to accomplish this, all disposal areas must be directly sampled and analyzed for an appropriate range of contaminants. Vertical composites of borehole samples should be limited to maximum 2-ft intervals so that contaminant levels can be established with an appropriate degree of resolution. These data are critical to the evaluation of remedial alternatives.

v I p 1-3

In several instances, known contaminants historically disposed of in an area were not included in the RI sample analyses (e.g., lithium at the reactive metal destruction area, polynuclear aromatic hydrocarbons at the oil burn pit). Other contaminants for which insufficient data exists to characterize known historic disposal areas include (but are not limited to) strontium, cesium 137, acetone, bis(2-ethylhexyl)phthalate, toluene, polychlorinated biphenyls, di-n-butylphthalate, 2-butanone, and chloroethane (B series ponds).

v.II pl. 4-1

v II pl. 4-1

v II p 4-43

All potential contaminant sources within a disposal area have not been adequately characterized. Disposal ponds have been sampled for surface waters, but bottom sediments in most historic disposal ponds have not been sampled. A definition of the concentration, nature, and extent of contamination in all disposal areas is necessary to evaluate remediation alternatives, including disposal criterion. Examples of locations where no sampling has been conducted within the disposal or storage area to characterize the lateral and vertical extent of contamination include the 903 drum storage-pad, most of the east trenches, the oil burn pit, the pallet burn pit, and trenches. This includes virtually all of the SWMUs located in the three areas of concern. Other SWMUs (e.g., the mound site) have been characterized using samples composited over excessively large depth intervals from boreholes located in a very limited portion of the SWMU. After drums were removed from the 903 drum storage area, plutonium contaminated soil was "scraped .. into a relatively small area." This area needs to be located, sampled, and the volume and concentrations of contaminants evaluated.

Analytical Program, Quality Assurance, and Data Management

The analytical program and data management practices employed in the RI do not provide data of the appropriate quantitative quality that are needed to conduct the feasibility study (FS). Specifically, the three main problems with this portion of the RI are laboratory quality assurance/quality control (QA/QC), field QA/QC, and data management practices. Most of these problems, as described below, stem from the fact that overall project and QA/QC is based on a generic plan that does not define site-specific data quality objectives (DQOs). The DQOs are qualitative and quantitative statements that specify the quality of data needed to support decisions made in the RI/FS process, and are determined by the end use of the data collected (U.S. EPA 1987b). For example, data may be used for site characterization, evaluation of remedial technolgies, or to determine design criteria. The detail and quality of data needed for each of these tasks varies, and must be determined on a case-by-case basis. DQOs should be incorporated in both the sampling and analysis plan and the quality assurance project plan (QAPP). The U.S. EPA document (1987b) provides guidance on the development of DQOs.

Laboratory QA/QC

Of the three major problems, laboratory QA/QC is of special concern. Inadequate laboratory QA/QC results in analytical data that arenot adequate for site characterization or design purposes, and may require that additional samples be collected and analyzed using proper QA/QC practices to verify or refine existing data. As discussed previously, the required site specific DQOs concerning analytical methods, detection limits, and QA samples must be developed to ensure that high-quality usable data are produced, and that data fulfills the intended purpose. Specific lab QA/QC problems in the RI are discussed in detail below.

Analytical methods were changed midway through the RI, from gas chromatography (GC) to gas chromatography/mass spectroscopy (GS/MS), with insufficient discussion provided in the report to evaluate data quality and comparability. The discussion should focus on possible effects that the change in methods could have on the data, and on quality assurance measures taken to characterize these effects. These measures should have included analyzing split samples or standard reference materials (SRMs) to provide quantitative data on differences between the two methods. Also, no discussion is presented concerning how the QA plan was modified to reflect the change in analytical methods. Because the analytical procedures used are referenced to the Installation Generic Monitoring QA/QC Plan (authored by U.S. DOE, not available for this review), an evaluation of either method was not possible. Analytical methods used must provide data of similar quality and precision to those required under RCRA and/or CERCLA (U.S. EPA 1984, 1986a, 1987c, 1987d).

v.II p. 4-3 Laboratory and field blanks regularly exhibited contamination with several different organic compounds (methylene chloride, acetone, 2-butanone, trichloroethene), possibly indicating improper sample handling and analysis procedures. Standard QA measures were not v.X p G-10 employed. For example, method spikes were not used, nor were lot control numbers assigned for water samples collected in the first and second quarters of the RI sampling effort. There is no mention of the analysis of SRMs to measure accuracy. Also, no QA/QC data are available v.X p. G-8 for third and fourth quarter analytical reports. The QA/QC plan, summarized in Appendix G, states that field and trip blank needs are reduced by using pre-cleaned bottles. This is not justifiable due to the frequent detection of trace levels of contaminants in the most meticulously cleaned analytical glassware.

Field QA/QC

Problems and inconsistencies also exist with field QA/QC pro- v.V p D-20 cedures. Appendix D states that samples collected for radiochemical analyses were not filtered during first and second quarter sampling, but were filtered during the third and fourth quarters. A discussion of why the change in sample filtering procedure occurred and how it v V p. D-20 affects the data should be presented Appendix D also states that surface water samples were not filtered prior to radiochemical analysis. v X p. G-5 Appendix G states that surface water samples were not collected during the first quarter, were collected and not filtered during the second and third quarters, and were collected and filtered during the fourth quarter. Thus, Appendix G apparently contradicts Appendix D with respect to the filtering of surface water samples. Also, no discussion is presented concerning why the sampling approach (whichever one is correct) was taken and why it was changed midway through sampling for the RI. Both filtered and unfiltered samples should have been collected for groundwater and surface water. This approach would facilitate a comparison of total and dissolved contaminant concentrations.

The actual sample volumes of groundwater radiometric samples were much lower during the first three quarters of sampling than the volumes
v.X
p. G-7
required by the QA/QC plan. The report contains the statement, "the small volume of these low-level samples has the effect of raising detection limits and relative uncertainty due to low sample count rate." The quantitative significance of the detection limits associated with the different sample volumes is not adequately addressed. Fourth quarter sample volumes were changed back to the 1-L volume originally required by the sampling plan. While this change may produce better results, it may preclude comparison with the first three quarters of data and compromise conclusions based on such a comparison.

Data Management

v IX
Data management and reporting is lax in the RI report. Data presented in the RI (Appendix F) for volatile organic compounds (VOC) lists only those compounds that were detected. For each sample, all analytes and their corresponding sample specific detection limits need
v IX
v X
p G-8
to be listed. Data tables with blank spaces or "not reported" entries provide no information and are not self explanatory The QA plan reports that all data was entered into a technical database. No discussion is provided of the QA procedures used to check data entry

Criteria for data rejection or qualification are not presented. Data are subjectively discounted wherever they are either higher than "normal" or close to background levels For example, values are
v III
p 5-20
labeled as "outliers" (and excluded from the data set) solely because

they are "inconsistent in magnitude" with other values By excluding high values as outliers during the characterization phase of the RI, it is not possible to determine the maximum concentrations of contaminants in affected media or to identify "hot spots." It is therefore recommended that all data be considered in the characterization phase, unless there is compelling evidence (e.g., rigid statistical evaluation) that justifies the exclusion of any data as representing "outliers." Another similar example is that values as high as two or three times background are often described as "natural geochemical variations" of the groundwater. This claim is not documented, and no independent data is presented in the RI demonstrating that this magnitude of natural variation in groundwater quality exists.

v.III
p. 5-25

Existing Containment

Containment exists for the T-1 trench, the 903 drum storage area, and the east trenches. The T-1 trench has been covered with approximately 2 ft of soil. The east trenches have reportedly been "covered with soil." The 903 drum storage area was scraped, covered with fill material, and topped with an asphalt containment cover. No other containment structures at the facility were noted in the RI for known waste disposal and storage areas. Containment does not exist for many of the SWMUs, including the mound area, that have documented radionuclide contamination in surface soils.

v.I
p. 2-14
v.II
p. 4-43

EVALUATION OF POTENTIAL RISKS

Public Health and Environmental Risk

In general, the Public Health and Environmental Concerns (Section 9) portion of the draft RI report contains many conclusions that are based on a qualitative and highly subjective discussion of the available data The validity and substantive nature of these conclusions can only be determined upon an evaluation of the data that quantitatively describes the temporal and spatial distribution of contaminant concentrations in various media (i e , air, surface water, groundwater, surface soils, subsoils, sediments, and biota) within the site boundaries, and in offsite areas The results of this analysis should then form the basis of environmental and public health risk assessments. Indications that the risk assessment approach was considered, or that risk assessment guidelines were even consulted, are virtually absent in Section 9.

Public health risk assessment methods are described in the Superfund Public Health Evaluation Manual (U.S. EPA 1986b). At a minimum, the public health risk assessment should include a hazard assessment and selection of chemicals of concern for the site, an exposure assessment, a toxicity assessment, a risk characterization, and an uncertainty analysis. The results of the risk analysis may then be summarized in the potential receptors and public health impacts sections of the RI report.

In the environmental impacts section, the RI states that there are no ecological impacts in the vicinity of the site the following reasons:

- o The contaminated areas are not used, nor intended for use, as public or recreational areas, nor for the development of unique natural resources

- o Unique ecosystems or endangered species have not been observed in the vicinity of the site

- o Biota or flora present in these areas do not exhibit obvious stress.

These conclusions are virtually impossible to verify from the information presented in the RI report, and raise the following questions

- o What do intended public, recreational, and resource uses have to do with an evaluation of ecological impacts?

- o Why would one conclude that there is an absence of ecological impacts simply because "unique ecosystems" or endangered species have not been observed at the site? (The absence of "unique ecosystems" and endangered species could possibly be an indication of a stressed environment.)

- o What "obvious" signs of stress would one look for given the range of habitats and chemical contaminants in the vicinity of the site, and how were any indices of ecological stress, if any, quantified?

v.IV p 9-1 The RI notes that approximately 1,585 individuasl live within 4 mi of the Rocky Flats Plant, and presents a list of 13 wells within 2 mi of the study area, including the nearest downgradient wells. It is also stated in the RI that the major use of the wells is for drinking water and stock watering. No estimate of the population at risk from the groundwater pathway is provided. A field survey of these wells would provide that information. The RI fails to address future population changes and how those changes may impact the groundwater flow system. Such changes may affect the choice of remedial measures for the groundwater flow system. Estimates of future water use can be made from information available from county planning agencies and water resource planning agencies.

v IV p 9-4 Groundwater use for each well within 2 mi of the study area is provided in Table 9-1 using a numerical system, but no key is provided to determine what the numbers mean. An explanation of the coding system should be provided. Table 9-1 also does not provide data concerning well construction (depth of screened interval) and quantity of water used This information is available in the notice of beneficial use that is filed with the state engineers's office. The Hazardous Ranking System used to rank sites for inclusion on the National Priorities List considers all wells within 3 mi of the contaminants. The listing of wells should be expanded to include wells within this distance to maintain consistency, and should address abandoned wells that could serve as conduits between aquifers or form surface contamination Potential groundwater use is not provided in the text as directed in 40 CFR Part 300, Section 300.68(e)(2)(v) (U.S EPA 1985). This information can be estimated using data obtained from county planning offices or from water resource planning agencies

In summary, the ecological impact analysis in the RI report should focus on the temporal and spatial distribution of contaminants throughout the site and in offsite areas, and on how these contaminants may affect local biota. Key considerations in this analysis should be on comparisons of ecological and toxicological variables along a contaminant gradient, and in uncontaminated reference areas. Ecological variables in these comparisons should include species abundances, richness and diversity, and an evaluation of biotic groups that are likely to be tolerant or sensitive to the contaminants in question. Toxicological variables should include medium-specific LC_{50} or EC_{50} values and their associated dose-response relationships describing the chronic or acute effects of the contaminants of concern. This information may be used to compare environmental concentrations of contaminants that are considered hazardous or toxic to biota with ambient concentrations in the vicinity of the site and in reference areas.

Potential for Future and Ongoing Releases

Based on information presented in the RI report, it is apparent that organic and inorganic contaminants have been and will continue to be released into the environment by multiple pathways unless remedial actions are undertaken. Groundwater contaminated with high levels of chlorinated solvents has been shown to be migrating in both the alluvial and bedrock aquifers. Contaminants in the alluvial aquifer can enter surface waters via seeps, and downward directed vertical gradients promote leakage into the bedrock aquifer, allowing contaminated groundwater eventually reach water supply wells and surface water supplies.

Surface waters at the site have been shown to receive contaminants via seeps and airborne particulates. Once contaminants are in the surface water or sediments, there appears to be a high probability that they will migrate offsite and eventually reach two reservoirs downstream that serve as recreation areas and municipal water supplies.

Surface soils at the site, while not adequately characterized, are known to be contaminated with metals and radionuclides, including plutonium and americium. Airborne transport of these contaminated surface soils has been documented and will continue unless remedial measures are taken.

RECOMMENDATIONS

In general, work conducted in accordance with applicable federal regulations for the conductance of remedial investigations (U S. EPA 1985, 1987a) and addressing data gaps identified in this review would substantially improve the quality of a subsequent RI report. Field studies should be conducted in accordance to a detailed, site-specific sampling and analysis plan developed using clearly defined site-specific and task-specific data quality objectives (U.S. EPA 1987b). Any subsequent modifications or deviations from either the field protocols or the analytical methodologies specified in the sampling and analysis plan should be thoroughly documented, explained, and impacts of the changes identified. Particular attention should be devoted to obtaining the data needed to accurately characterize contaminant sources in the three areas of concern, to background contaminant levels, and to determine whether what appears to be to be anamolous data values are truly outliers, or if they merely identify maximum contaminant levels. Contaminant migration pathways for all media should be carefully examined on a site-wide basis. The applicability and acceptability of such data can be assured by adherence to laboratory and field quality assurance and quality control objectives set forth in U.S. EPA guidance documents (U.S. EPA 1987b). By employing acceptable data management techniques, this data could then readily be used to perform a comprehensive risk assessment following U.S. EPA guidelines (1986b).

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