From: "Michael Tucker" <Michael.Tucker@gjo.doe.gov>
To: <rwv@nrc.gov>
Date: 8/25/05 11:40AM
Subject: FW: Lakeview response to NRC

Bill - attached is a copy of a white paper on DOE's position that "no further action" is the appropriate compliance strategy at the Lakeview site, and a copy of our response to the NRC request for further information dated January 29, 2004. These are advance "informal" copies, and the originals will be forthcoming with a transmittal letter in the near future.

As an update, we conducted the annual inspection of the Lakeview site in July. At that time, the Stoller project manager (Dick Dayvault) and I met with Mr. & Mrs. Davis to discuss their unique situation. The Davises Property is inside the Institutional Control area, and they are using domestic water from a well that is 155 feet deep. They have good water (no elevated contamination levels) and really wish that everyone would just leave them alone.

We explained the situation to them that the State had passed Institutional Controls for that area, and we felt that DOE was required to take some action. What we proposed to them is that DOE would take one of the 3 following actions at no cost to them; 1) we would hook them up to city water; 2) we would install a reverse osmosis water treatment unit; or 3) that if we had to, we would drill a new well for them which would be greater than 250 feet in depth (to meet Institutional Control requirements)

The 1st option is not acceptable to Mr. & Mrs. Davis - they went on for some time about how they moved to their present just address to get out of the city of Lakeview, and then the city annexed their area into the city. They emphatically stated that there was no way that they would hook up to city water. They were fairly interested in learning about the reverse osmosis treatment possibility. We have gathered information of the various treatment units, and will be sending it to them in the near future. Mr. Davis asked that if we drilled a well greater than 250 feet in depth, if DOE would guarantee that they would have equal or better water than they do now. We said every indication is that water at that level is generally of a quality comparable to what they now have, but no we could not guarantee better water.

My question is, Would installation of the reverse osmosis water treatment unit at the Davis property, meet NRC requirements for protection of the public health - realizing that they live inside the Institutional Control area and are using domestic water from a well that is only 155 feet deep?? If not, we will have to get together again with the Davises, and see if option 3 is acceptable to them.

On a more personal side, DOE has offered an incentive for employees to accept early retirement, and it was so good that I couldn't help but accept their kind and generous offer. So September 1st is my last day with DOE, and I am going to retire and enjoy life for awhile. My wife and I are staying in the Grand Junction area (after 23 years it feels like home), and plan to do a little traveling. When I get bored, I'm then going to try remodeling our house.

I've enjoyed working with you in the past, and wish you well in the future.

> -----Original Message-----
> From: Richard Dayvault
> Sent: Wednesday, August 24, 2005 9:44 AM
> To: Michael Tucker
> Cc: Clay Carpenter
> Subject: Lakeview response to NRC
>
>
> Mike,
>
> Per our discussion, here are the two Lakeview files, the white paper and NRC responses, for Bill Von Till. I will also formally transmit them to you.
>
> Dick

>
> > <<lakewhite.doc>> [Michael Tucker] > > <<LakeNRCresponses.doc>>
> Richard D. Dayvault
> Project Scientist
> S.M. Stoller
> ph: 970-248-6375
> fax: 970-248-6040

CC: "Richard Dayvault" <Richard.Dayvault@gjo.doe.gov>

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Subject: FW: Lakeview response to NRC
Creation Date: 8/25/05 11:40AM
From: "Michael Tucker" <Michael.Tucker@gjo.doe.gov>

Created By: Michael.Tucker@gjo.doe.gov

Recipients
nrc.gov
twf4_po.TWFN_DO
RWV (Bill VonTill)

gjo.doe.gov
Richard.Dayvault CC (Richard Dayvault)

Post Office	Route
twf4_po.TWFN_DO	nrc.gov
	gjo.doe.gov

Files	Size	Date & Time
MESSAGE	3752	08/25/05 11:40AM
lakewhite.doc	40448	
LakeNRCresponses.doc	71168	
Mime.822	158303	

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RATIONALE FOR DOE'S SELECTED COMPLIANCE STRATEGY FOR THE LAKEVIEW, OREGON, UMTRA GROUND WATER SITE

The U.S. Department of Energy (DOE) believes that "no further action" is the appropriate compliance strategy for ground water associated with the former Lakeview Uranium Mill Tailings Remedial Action (UMTRA) Project site. The main objective of the UMTRA Ground Water Project is protection of human health and the environment. DOE believes that this objective has been achieved through removal and off-site disposal of mill tailings and associated materials from the site (i.e., source removal) and the implementation of institutional controls in the site vicinity. DOE does recognize that some wells in the vicinity of the site do contain levels of some constituents that exceed regulatory limits. However, it is DOE's position that the institutional control boundary and associated well construction requirements adequately address any residual contamination for which DOE has responsibility. Any contamination outside the institutional control boundary can likely be attributed to other sources— natural, man-made, or both.

The Nuclear Regulatory Commission has stated that they cannot approve groundwater standards at the Lakeview site that are less stringent than those initially imposed at Title II sites (i.e., MCLs) unless DOE can either conclusively demonstrate that groundwater contamination is not site-related or that active remediation will be ineffective (presumably through implementing an active remediation system that subsequently proves to be ineffective). DOE believes that this position cannot be justified for several reasons. DOE has reviewed remediation approaches at a number of Title II sites and believes there are significant differences between those sites and the Lakeview site. At Title II sites with which DOE is familiar, the tailings piles were reclaimed in place onsite. At the Lakeview site, the tailings and associated materials were relocated to an engineered offsite disposal cell, therefore removing potential ongoing ground water contaminant sources. At most Title II sites, contaminant concentrations in ground water were much higher than noted at the Lakeview site, with uranium concentrations on the order of more than 1 mg/L and sulfate over 10,000 mg/L. A wider range of contaminants was also present at most Title II sites and it could conclusively be shown that they were site-related. Additionally, active remediation was performed only when constituents in groundwater had enforceable standards. At Lakeview, the contaminants in question by NRC—manganese and sulfate—only have unenforceable standards (secondary drinking water standards). Finally, in a compilation of data regarding decommissioning of Title II sites, it is noted that the average total cost of reclamation of a Title II site (tailings and ground water) is approximately $14 million (DOE/EIA 1995). This is less than the total expenditure to date at the Lakeview site.

From a regulatory perspective, the framework under which DOE operates is different than that applied to Title II sites. DOE has three basic remediation options for groundwater—no remediation, natural flushing, or active remediation. Active remediation is the option of last resort when no other approach applies. According to DOE's ground water PEIS (DOE 1996a), a "no remediation" compliance strategy is

appropriate when ground water meets one of four standards: background, maximum concentration limits (MCLs), supplemental standards, or alternate concentration limits (ACLs). MCLs only exist for only two contaminants of concern (COCs) associated with the Lakeview site—arsenic (0.05 mg/L) and uranium (0.044 mg/L, assuming isotopic equilibrium). The other identified COCs—chloride, sodium, manganese, sulfate, and total dissolved solids (TDS)—have only nonenforceable secondary standards or health advisories; additionally, evidence exists that there are other, nonsite-related sources for these COCs as well as for arsenic.

Arsenic levels in the vicinity of the site are above the MCL, but are below the maximum background concentration observed upgradient of the site at Hunter's Hot Springs. Geothermal fluids associated with the hot springs are likely a major source of arsenic in the area, though arsenic-rich ores also were processed at the Lakeview millsite. Lacustrine sediments, like those that exist in the surficial aquifer at Lakeview, have been demonstrated to be a source of arsenic in ground water in similar geologic settings throughout the western U.S. (Welch and others 2000) and may also provide a ready source of arsenic. These types of deposits are found throughout the Goose Lake graben. Supplemental standards were applied to ground water at the Salt Lake City uranium processing site and disposal cell because of elevated concentrations of arsenic in ambient ground water; the geologic setting in the Salt Lake area is the same as that associated with the Goose Lake graben.

Uranium is present in detectable concentrations at the Lakeview site. One on-site well exceeded the MCL for uranium on one occasion in 2003; however, the 2004 sampling round indicates it had decreased to below the standard. At most processing sites, uranium is a major indicator of site-related contamination and is usually widespread and present in high concentrations. The absence of significant uranium contamination at the Lakeview site suggests that site-related contamination is limited.

The sulfate plume apparently emanating from the former raffinate pond area has been used in the past to identify the extent of site-related contamination and formed the basis for establishing the current institutional control boundary. However, isotopic data for sulfur presented in the Remedial Action Plan (RAP; DOE 1992) indicates the site-related influence may be less extensive than originally thought. Isotopic analyses demonstrated that sulfur at the downgradient portion of the sulfate plume is geothermal in nature and does not have the site-related signature of the raffinate ponds (the main source of potential ground water contamination; see attachment 1). It is not clear whether this geothermal sulfur was transported through the ground water system from the geothermal area or is the result of recharge from Warner Creek, which received water from the hot springs.

For the other COCs at the Lakeview site, background concentrations are ambiguous because of the complex geologic and topographic nature of the Goose Lake Valley and the location of the site in an area influenced by human activity. Wells that have been used as background wells in the past at Lakeview (since abandoned) were located at the base of the mountains adjacent to a creek that provides freshwater recharge to the alluvial

aquifer. These wells yielded ground water with fairly good quality, though state standards for manganese and iron were exceeded (DOE 1996b) at times and federal standards have been exceeded for nitrate. The last time background samples were collected was 1995. It is highly likely that background samples collected today from similar locations could have much different chemical signatures (higher concentrations of dissolved constituents) because of the severe drought that has persisted in the west over the last several years.

Contamination at the Lakeview millsite was relocated to the Collins Ranch disposal site from 1986 to 1989. At other Title I sites where contamination was removed from the original millsite, concentrations of COCs have decreased with time. This has not been the case at the Lakeview millsite. Concentrations have remained relatively steady since the remedial action and continue to change little. This suggests a steady state condition exists for constituents in the ground water, which is not going to change in the future.

To further complicate matters, a large portion of the valley was once occupied by high salinity water in Goose Lake and historic background wells may not be representative of background throughout the valley. Salts precipitated from the historic lake are present in the lacustrine sediments in the shallow aquifer. These salts are likely to be more abundant closer to the valley's interior and away from the mountains. Chloride, sodium, and sulfate are all commonly found in such deposits. Dissolution of those salts in recharge areas such as canals, streams, irrigated areas, geothermal areas, and other surface water bodies (e.g., former logging ponds) likely resulted in a heterogeneous mobilization of salt-related constituents throughout the shallow ground water system. Therefore, background (i.e., non-site-related) ground water is likely to have a highly variable composition due to both natural variability and the influence of human activity. This is typical of Class III ground water, as described in EPA's *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy* (EPA 1988).

EPA (1988) describes Class III ground water resulting from broad-scale human activity as follows:

> In general, ground-water contamination due to broad-scale human activity is characterized by multiple constituents. Both constituent concentrations and the suite of constituents will also vary from point to point. Water-quality data would be expected to show the presence of relatively high concentrations of a few ubiquitous compounds, together with lower concentrations of a larger number of other constituents. The most commonly reported (i.e., ubiquitous) ground-water pollutants include chlorinated solvents; pesticides; miscellaneous hydrocarbons, such as gasoline; metals; salinity; and radionuclides (USEPA, 1985). The entire ground-water unit being classified does not necessarily have to meet Class III untreatable criteria, but a major volume portion would. The definition of such significant portion is left to the professional judgment of the classifier.

The shallow aquifer at Lakeview has not formally been designated as a Class III aquifer, but there is ample evidence to suggest that the high levels of certain

constituents—arsenic, chloride, manganese, sodium, and sulfate—are not solely site-derived and probably occur naturally in subsurface sediments. The uneven distribution can probably be attributable to differences in human activity across the area. A study of arsenic in groundwater in Idaho (Neely 2002), concluded that arsenic was likely naturally occurring, but the release to ground water was probably at least partly dependent on human activity (e.g., irrigation or other practices). A similar explanation may account for the irregular distribution of some constituents in the vicinity of the Lakeview site and the inconsistencies between concentrations measured in raffinate pond fluids with concentrations observed in the ground water.

Sulfate and manganese are detected onsite and downgradient (west and southwest) of the site at fairly high levels, but are also observed at elevated levels directly south of the site along Roberta Avenue. It was assumed, particularly for sulfate, that the plume apparently emanating from the raffinate pond area was site-related and that the sulfate along Roberta Avenue came from some other nonsite-related source. As noted above, there is evidence to suggest that the downgradient sulfur plume has a geothermal source based on isotopic data. It is also possible that the sulfur in the apparent site-related plume is not necessarily the result of sulfur disposed of in the raffinate pond fluids, but may be due to fluids entering the subsurface sediments and dissolving sulfate from naturally occurring salts. This could explain why sulfate concentrations observed in the ground water are actually higher than concentrations measured in raffinate fluids themselves (see attachments 2 & 3).

South of the site along Roberta Avenue, water present in the former logging ponds located upgradient of wells with elevated sulfate may have similarly dissolved naturally occurring sulfate salts as it percolated into the subsurface. Thus the distribution of contaminants across the area is more dependent on a source of recharge than the location of any point source of contamination. This is supported by the fact that concentrations of most constituents through time have remained relatively constant, indicating that steady state conditions prevail. Because source removal was completed in 1988, this is an indication that the site is probably not the main contributor to contaminants in the shallow ground water. At most other UMTRA ground water sites, particularly with such a large period of time since source removal, some reduction in site-related contaminants has been observed following source removal.

Based on the above discussion, DOE believes that a case can be made for the application of supplemental standards due to widespread ambient contamination even though, locally, water is of high enough quality to use for domestic purposes. DOE believes this supports a "no further action" decision for groundwater at the Lakeview site.

From a risk standpoint, the constituent that poses the greatest amount of potential risk—carcinogenic and noncarcinogenic—is arsenic because of its high toxicity. To measurably reduce any potential risks posed by ground water in the vicinity of the site (risk-reduction is the main driver behind DOE's remediation program), the focus of any active remediation would need to be on arsenic reduction. However, because arsenic is

naturally occurring and ubiquitous and source control is not possible, it is DOE's position that a "no further action" approach is appropriate for the Lakeview site.

- Any active remediation system would likely have little real impact on ground water quality and could actually lead to a more rapid spread of arsenic through the ground water system. Oxidation, which commonly occurs with disturbance of a subsurface system, is known to mobilize arsenic and free it up for transport through the environment. The distribution of arsenic in the subsurface at the Lakeview site is not known, but naturally occurring arsenic is likely contained in lacustrine sediments. Arsenic derived from site-related processes or transported from the geothermal area is likely also sorbed onto subsurface materials. The subsurface in the vicinity of the site is known to be extremely heterogeneous with discontinuities both laterally and vertically; design of an effective ground water recovery system would be extremely difficult.

The site is located between the Hunters Hot Springs—one source of the arsenic—and private well users to the south. Water collected from some of those private wells in 2002 exceeded the new primary drinking water standard for arsenic, which goes into effect in 2006 (10 ug/L; they are below the current standard of 50 ug/L). High levels of arsenic are observed in the surface water to the north and west of the site, possibly because the surface waters are more oxidized. If an active remediation system were installed onsite (the presumptive remedy for ground water is pump-and-treat), there is the possibility that arsenic (site-related or natural) could be mobilized and have the potential to degrade water quality in areas that are not affected by the site or the hot springs. Water also could be pulled into the ground water system from the surface and result in increasing arsenic concentrations in the ground water.

Portions of the land south of the site have recently been annexed into the city and any new development will be required to use the city water supply as their source of drinking water. This will assure protection of human health, as will the institutional controls that were earlier approved by the State of Oregon. Surface water quality is compromised due to sources (manmade and/or natural) unrelated to the site. Any site-related impacts to surface water are minimal compared to this ambient contamination. DOE therefore believes that a "no further action" decision for Lakeview site ground water will be protective of human health and the environment with respect to site-related contamination.

DOE believes that a "no further action" decision for site ground water will comply with background concentrations and the MCL for arsenic and uranium, respectively. These are the only site-related constituents with enforceable standards. Onsite levels of arsenic are below background concentrations observed at Hunters Hot Springs. The MCL for uranium was exceeded only at a single onsite well on a single occasion. UMTRA ground water regulations (40 CFR 192) for disposal indicate that temporary excursions from applicable limits for ground water concentrations do not constitute a basis for taking corrective action. It is assumed that the same logic applies to ground water at cleanup sites.

Because there are no enforceable standards for the other constituents identified as COCs for the site, active remediation cannot be justified. Because some of these constituents are likely to be naturally occurring (in addition to arsenic), DOE believes that appropriate compliance standards for those constituents are supplemental standards. It is believed that supplemental standards apply for three reasons:

- Ground water is limited use based on widespread, ambient contamination unrelated to activities involving residual radioactive materials from a designated processing site;
- Remedial action has the potential to produce damage that is excessive compared to benefits;
- Restoration of ground water quality at the site is impracticable due to (1) the continuing source of arsenic from the hot springs; (2) the presence of naturally occurring salts in the subsurface, which also provide a nearly unlimited source of soluble contaminants (sodium, chloride, sulfate); and (3) the extremely heterogeneous nature of the subsurface (laterally and vertically) which greatly complicates the design of a ground water recovery system.

Furthermore, the presence of constituents such as manganese and sulfate in domestic water systems produces unwanted effects (e.g., fixture discoloration, unwanted tastes or smells) at concentrations below which adverse health effects may occur. These unwanted effects are a deterrent to use of untreated water for drinking. Private well users on Roberta Avenue have voluntarily installed treatment units for their drinking water systems or only use the water for nondomestic purposes (DOE 1992).

REQUEST FOR INFORMATION
DEPARTMENT OF ENERGY GROUNDWATER COMPLIANCE ACTION PLAN
FOR THE LAKEVIEW, OREGON, UMTRA PROJECT SITE

NRC Comment

1. Action: Analyze the groundwater compliance strategy utilized at the Lakeview site. Revise the groundwater compliance strategy to comply with the provisions of 10CFR 192.

Basis: DOE proposes that no remediation be undertaken based on *limited use groundwater* and application of supplemental standards to achieve compliance with Subpart B or 40 CFR 192 at the former Lakeview millsite. *Limited use groundwater*, per 40 CFR Part 192.11(e), is defined as:

> Groundwater that is not a current or potential source of drinking water because (1) the concentration of total dissolved solids is in excess of 10,000 mg/l, or (2) widespread, ambient contamination not due to activities involving residual radioactive materials from a designated processing site exists that cannot be cleaned up using treatment methods reasonably employed in public water systems, or (3) the quality of water reasonably available for sustained continuous use is less than 150 gallons per day. The parameters for determining the quality of water reasonably available shall be determined by the Secretary with the concurrence of the Commission.

As the compliance strategy proposed is supplemental standards based on limited use groundwater, DOE must show that groundwater is not a current or potential source of drinking water. However, water is currently being consumed from a domestic well at location 0543 that is in the immediate area of the former mill and the contaminant plume. Since water is currently a source of drinking water, the compliance strategy of using supplemental standards based on *limited use groundwater* cannot be applied to this site.

DOE Response

DOE still feels that the appropriate compliance strategy at the Lakeview, Oregon millsite is no further action based upon *limited use groundwater* due to *widespread ambient contamination*. However, DOE also believes that supplemental standards can be applied based on the fact that the potential to mobilize natural arsenic through active remediation may result in environmental damage that outweighs any potential benefit. In addition, the presence of naturally occurring contaminants in the subsurface and at the geothermal area, in conjunction with an extremely complex and heterogeneous subsurface, render active remediation of the ground water system impracticable. Several actions have been taken (and will be taken) which make no further action a viable strategy.

On April 1, 2004, the Oregon State Water Resources Department prolmugated a rule designating the Lakeview millsite as a "Special Area" in which any new, altered, deepened or converted well shall be cased and sealed from 250 feet below land surface. (Oregon State rule 690-200-0028)". This established an 'Institutional Control' area encompassing the existing millsite. (A copy of the Oregon State administrative rules is Attachment 4).

In 2002, DOE negotiated with the town of Lakeview and Lake County officials to increase the diameter of a domestic water line that was being constructed by the town of Lakeview to a new state prison located north of town. This construction was completed in the fall of 2002. The corridor for the water line intersects the southern and eastern sides of the IC area and will provide municipal water to residents inside the IC zone. DOE paid $200K to fund the cost for increasing the diameter of the waterline. In exchange, Lake County and the town of Lakeview both passed ordinances requiring future land users inside the IC area to hookup to the new city water line, or install a well deeper than 250 feet in depth.

These actions provide an alternative domestic water source for any new construction that may take place within the special institutional control area.

One household within the IC boundary had been using ground water as a source of drinking water. Water from this well has and will be monitored in the future. However, the area where this household is located has recently been annexed into the city limits. This residence will be required to hook up to city water if their well ever fails, but not until that time. DOE recently visited with this property owner and offered to 1) hook up the residence to municipal water, 2) provide a deeper well, or 3) provide and install a reverse osmosis unit. The landowners indicated they would absolutely not hook up to City water and would prefer a reverse osmosis unit to polish up their water. They were also not overly interested in a new well, which may or may not provide better water than they currently access. After one of these three options is exercised, the shallow alluvial system within the IC boundary will no longer be a current or potential source of untreated drinking water. At that time, DOE feels that NRC would be correct in approving the application of supplemental standards based upon *Limited Use Groundwater* in accordance with the requirements of 40 CFR 192.11(e).

NRC comment:

2. Action: Determine and justify background contaminants of concern in the main portion of the Lakeview valley around the former millsite.

Basis: The Base Line Risk Assessment (BLRA) identified several constituents of concern. DOE argues, in section 2.3.3 of the Ground Water Compliance Action Plan (GCAP), that there is a problem with the previous evaluation because only a single well or well pair was used to represent nongeothermal background water quality and that this well pair was located near the base of the mountains along Hammersley

Creek. The well pair location along the base of the mountains and near the creek receives recharge essentially directly from the mountains and that water quality may not be indicative of background water quality in the main portion of the valley.

This is a plausible argument. However, if this argument is accepted, DOE does not have background water quality wells at the site indicative of the main portion of the valley. Any compliance strategy that relies on background water quality, such as supplemental standards based on *limited use groundwater*, would therefore have no basis.

DOE Response

It is important to remember that the Lakeview, Oregon site was operational for a very short period of time (less than 3 years) over 40 years ago, and the tailings (which are assumed to be a source of the contamination) were removed over 18 years ago. Monitoring at the site has occurred for the last 20 years. At other UMTRA sites with similar contaminants, decreasing contaminant concentrations have generally been observed over a similar time frame. Slight decreasing trends in some contaminants have been observed at Lakeview, however concentrations of most constituents have remained relatively constant. One may reasonably argue, that the ground water at the Lakeview, Oregon site may have already returned to, or is approaching, 'background' levels. This is supported by the lack of significant uranium in ground water at the site; uranium is a typical indicator of site-related contamination at most UMTRA ground water sites.

Only three constituents found in the ground water and surface water at the Lakeview site have exceeded UMTRA standards– they are arsenic, molybdenum, and possibly uranium.

Since 1990, uranium concentrations in well 540 had been slowly increasing, but did not exceed the UMTRA maximum concentration limit (0.044 mg/l) until March 2002, when it sharply increased to 0.057 mg/l. However the well returned to below UMTRA standards in the 2004 sampling event, to 0.011 mg/l. The other four wells being monitored have not exceeded UMTRA standards since 1990, and are currently at less than one-half the standard.

DOE cannot explain the spike in the uranium concentration in well 540 in 2002, however we will continue to monitor the groundwater for uranium. We feel that uranium should not be a PCOC in the future.

There are over 20 thermal springs and wells in the Lakeview area (Goose Lake basin). Seven thermal springs and wells located near the site were sampled, and water in six of the wells exceeded the UMTRCA maximum concentration limit (MCL) for arsenic (0.05 mg/L). Arsenic concentrations ranged up to 0.162 mg/L, with the highest value occurring in Hunter Hot Springs, just north of the Lakeview

site. Geothermal water from Hunter Hot Springs feeds into the creek and the ponds north of the site, and the subsurface beneath the site.

Nongeothermal water upgradient of the site was sampled to provide an indication of background. Two locations adjacent to Hammersley Creek, which has headwaters in the Warner Mountains, were sampled from the mid 1980's to mid 1990's. These wells yielded ground water with fairly good quality, though state standards for manganese and iron were exceeded (DOE 1996b) at times and federal standards have been exceeded for nitrate. The last time background samples were collected was 1995. It is highly likely that background samples collected today from similar locations could have much different chemical signatures (higher concentrations of dissolved constituents) because of the severe drought that has persisted in the west over the last several years.

An isolated area of groundwater located about 2,500 feet south of the site along Roberta Avenue, has elevated concentrations of sulfate, chloride, sodium, calcium, manganese, and iron. These constituents were probably related to the presence of logging ponds and leaching of subsurface salts. Pacific Pine Products, a lumber company, has a logging operation that used the former raffinate ponds and may have affected ground water quality in the vicinity of the site. Residents down gradient of the site have stated that the logging operations have adversely affected water quality in some of their private wells.

One source of the arsenic in the Lakeview area is the geothermal springs; arsenic is also probably contained in the subsurface lacustrine sediments. Current and past logging operations have also contributed a lot of contamination to the shallow ground water aquifer near the Lakeview site through leaching of these natural deposits.

The elevated values for molybdenum may be site related, but molybdenum has also been identified as a common trace constituent in surface water contained in Goose Lake. The concentration of molybdenum in the groundwater at Lakeview marginally exceeded the UMTRA standard (UMTRA standard is 0.1 mg/L) at only 2 locations. The measured concentration of Molybdenum is below the risk-based concentration at all locations and below detection at most locations.

A highly saline lake, (Goose Lake) once covered the entire area surrounding Lakeview. Only the remnants of this larger lake currently exist today as the smaller Goose Lake, Summer Lake, and Lake Abert. Soils in the vicinity of the Lakeview site are described by the U.S. Department of Agriculture Soil Conservation Service as "sodic and saline" and unfit for lawns, topsoil, and embankments, due to excess salt. Goose Lake has contributed large amounts of salts into the sediments. The current water quality of Goose Lake is poor and not drinking quality. It would be expected that natural ground water from a closed lake setting (as examples, the Great Salt Lake, and Abert Lake and Summer Lake) would have high concentrations of natural contaminants, including molybdenum.

All of these natural phenomenon are sources contributing to the degradation of the groundwater in the Lakeview area, and DOE feels that NRC has sufficient reason to grant supplemental standards based upon *limited use groundwater* due to *widespread ambient contamination.*

NRC Comment

3. Provide verification to support the claim in section 2.4 of the GCAP that groundwater at the Lakeview millsite is Class III.

Basis: GCAP section 2.4 states that, "The UMTRA groundwater regulations in 40 CFR 192 note that the use of supplemental standards for limited use groundwater applies the groundwater classification system in Environmental Protection Agency (EPA) Ground Water Protection Strategy (EPA, 1988). Based on this strategy, limited use groundwater would be considered to be Class III." DOE must Provide EPA or State of Oregon documentation that the groundwater at the Lakeview site is classified as Class III.

DOE Response:

DOE does believe that the groundwater beneath the mill site in the Lakeview, Oregon area should be classified as Class III because it meets the EPA definitions as contained in 10 CFR 192.

The groundwater may be classified as Class III if:

(1) the concentration of total dissolved solids is in excess of 10,000 mg/l;

The highest concentration of total dissolved solids at the Lakeview, Oregon mill site are in the 6,000 mg/l to 6,500 mg/l range. The water quality in the Lakeview, Oregon area is poor, but it does not exceed the standard established in 10 CFR 192.

(2) widespread, ambient contamination not due to activities involving residual radioactive materials from a designated processing site exists that cannot be cleaned up using treatment methods reasonably employed in public water systems,

EPA has recognized that an entire aquifer need not meet Class III criteria (such as limited use based on poor ambient water quality) in order to be classified as a Class III aquifer. DOE believes that there is widespread, ambient contamination beneath the mill site located in the Lakeview, Oregon area which is not related or derived from the processing site (See response no. 2 above).

In the 'Notice of Proposed Rulemaking Hearing' issued by the Oregon Water Resources Department, the notice stated that the USDOE has determined that the water quality within the IC boundary is unfit for human consumption. The Oregon Water Resources Department agreed and endorsed the DOE classification by adopting the Special Area Standards for the Lakeview area.

Based on the above, DOE feels that the Class III designation does apply to the shallow groundwater aquifer beneath the Lakeview mill site.

(3) the quality of water reasonably available for continuous use is less than 150 gallons per day.

This criteria does not apply to Lakeview, Oregon, as more water than 150 gallons per day is available in the shallow groundwater aquifer.

4. Action: Further characterize the site to identify the contaminant plume boundary.

Basis: The extent of the groundwater contamination plume has not been identified. This is especially true to the west and south of the former raffinate and tailings ponds. Well 0518 contains elevated levels of chloride, sodium, manganese, sulfate, and total dissolved solids that presumably are mill site related, however, there are no additional well locations down or cross gradient to this well. Additional wells are necessary to define the extent of mill site contamination.

The sulfate plume apparently emanating from the former raffinate pond area has been used in the past to identify the extent of site-related contamination and formed the basis for establishing the current institutional control boundary. However, isotopic data for sulfur presented in the Remedial Action Plan (RAP; DOE 1992) indicates the site-related influence may be less extensive than originally thought. Sulfur isotopic analyses demonstrated that sulfur at the downgradient portion of the sulfate plume is geothermal in nature and does not have the site-related signature of the raffinate ponds (the main source of potential ground water contamination; see attachment 1). It is not clear whether this geothermal sulfur was transported through the ground water system from the geothermal area or is the result of recharge from Warner Creek, which received water from the hot springs.

However, this does suggest that site-related contamination is not widespread. Other site-related constituents are identified within this plume (e.g., uranium) but are less pervasive. The plume is contained within the IC boundary implemented at the site. At this point in time, DOE does not feel that additional wells are either necessary or warranted. DOE is currently in compliance with the only enforceable standards that exist for COCs at the site (on-site arsenic is less than background and uranium is below its MCL). DOE does not believe that additional characterization is warranted for constituents that are of low toxicity and do not have enforceable standards.

DOE believes that contamination outside the IC boundary cannot be linked to the DOE Lakeview site. Any contamination west of the site is probably associated with surface and subsurface discharges from Hunter Hot Springs, whereas contamination south of the site is probably associated with Pacific Pine Products and the production of lumber products.

5. Action: Provide additional information that groundwater contamination located south of the site along Roberta Avenue is from another source, such as fill from former logging ponds, as opposed to uranium milling operations.

Basis: GCAP section 2.3.3 proposed that "The porous fill may have trapped rain water and allowed increased leaching of naturally occurring salts in the soils." Provide a basis for this statement.

GCAP section 2.3.3 proposes that "Anecdotal evidence from residents down gradient of the logging facility suggest that operations at the facility adversely affected water quality in some private wells." Clarify the anecdotal evidence used to support this statement.

GCAP section 2.3.3 states "The BLRA also indicated that additional data should be gathered to determine the source of the contamination in this southern area." The installation and removal of three piezometers adjacent to Roberta Avenue adds additional data, although limited, to support the theory that the logging ponds are responsible for contamination. Further investigation is necessary to prove that groundwater contaminant flow is the same as the flow direction indicated by the piezometric surface and that sources other than the mill site are responsible for the contamination.

DOE Response

The collective body of chemical and hydrological data complied for the Lakeview site point to contaminant sources other than those associated with the site, even though all of those sources cannot be definitively identified.

The entire site is contained within the bounds of the known geothermal resource area (KGRA) identified in the Lakeview vicinity. While the most obvious effects of the geothermal system are seen in the northern and western portions of the Lakeview site where geothermal waters discharge to the surface, isotopic data indicate that the effects extend to greater depths and distances from the geothermal surface expression. The extent of geothermal influence has not been completely characterized. Data collected during preparation of the environmental assessment and the surface remedial action plan for the site both indicate that the major source of ground water contamination was likely the raffinate ponds as opposed to the tailings pile.

Tailings were relatively dry while the raffinate ponds were used as storage areas for liquids after ore processing activities ceased, but before surface cleanup commenced. Therefore, the ponds could have served as an ongoing source of contamination. However, concentrations of fluids collected from the raffinate ponds (Table B.3.1, DOE 1992; attached) indicate concentrations of sulfate and manganese were actually relatively low in the ponds compared with recent concentrations of these constituents detected in ground water. Recent concentrations of manganese in wells 0503 and 0505 are higher than concentrations reported for the 20 historical raffinate pond analyses (attachment 2). These concentrations could be derived from the higher concentrations observed in the tailings pile, but would require a due west ground water flow direction. However, high

levels of manganese are also observed due south of the former tailings pile location. If derived from migration of tailings contamination, this would require a due south ground water flow gradient, whereas DOE data indicates a more westward flow.

Concentrations of both sodium and chloride in the ground water exceed historic concentrations in tailings and pond fluids and suggest dissolution of naturally occurring salts in lake sediments. A highly saline lake (Goose Lake) once covered the entire area and undoubtedly served as a source of ground water. Only the remnants of this larger lake currently exist today as the smaller Goose Lake, Summer Lake, and Lake Abert. These are classified as unsuitable for drinking water. All of these factors together indicate an interplay of numerous complex sources and processes that are further complicated by the heterogeneity of the subsurface.

A study of arsenic in groundwater in Idaho (Neely 2002), concluded that arsenic was likely naturally occurring, but the release to ground water was probably at least partly dependent on human activity (e.g., irrigation or other practices). A similar explanation may account for the irregular distribution of some constituents in the vicinity of the Lakeview site and the inconsistencies between concentrations measured in raffinate pond fluids with concentrations observed in the ground water.

Sulfate and manganese are detected onsite and downgradient (west and southwest) of the site at fairly high levels, but are also observed at elevated levels directly south of the site along Roberta Avenue. It was assumed, particularly for sulfate, that the plume apparently emanating from the raffinate pond area onsite was site-related and that the sulfate along Roberta Avenue came from some other nonsite-related source. As noted above, there is evidence to suggest that the downgradient sulfur plume has a geothermal source based on isotopic data. It is also possible that the sulfur in the apparent site-related plume is not necessarily the result of sulfur disposed of in the raffinate pond fluids, but may be due to fluids entering the subsurface sediments and dissolving sulfate from naturally occurring salts. This could explain why sulfate concentrations observed in the ground water are actually higher than concentrations measured in raffinate fluids themselves (see attachments 2 & 3).

A tremendous effort would be required to unequivocally characterize all contaminant sources and geochemical processes that affect ground water quality. There would probably be little benefit to be derived from such an undertaking. The most toxic constituent present in the ground water in the site vicinity is arsenic, which is present in highest concentrations in naturally occurring geothermal waters. There are no enforceable standards that exist for manganese and sulfate. These constituents are present in concentrations which would be of concern for health reasons; however, based on matters of aesthetic (taste and/or discoloring effects on fixtures, laundry), people generally treat water containing these constituents, even when they are at levels that are safe for consumption. All private wells in the area where manganese and sulfate are elevated have been voluntarily equipped with home treatment units, which reduce contaminant concentrations to safe levels.

6. Action: Identify additional compliance monitoring wells. Increase the number of monitoring well locations for long-term sampling at the institutional control (IC) boundary or propose other compliance monitoring well locations that will insure long-term compliance with groundwater protection standards.

Basis: There is only one well located at the IC boundary in the downgradient direction of the site that is proposed for long-term monitoring. Additional compliance monitoring wells at the IC boundary will insure that contaminants are not moving beyond the boundary. Other compliance monitoring wells, not at the IC boundary, can be identified through groundwater modeling that will show groundwater protection standards will be met at the boundary.

DOE Response

DOE believes that the current monitoring network is adequate for assuring compliance with standards. As noted previously, the only two constituents for which enforceable standards exist and arsenic and uranium. Arsenic at the site is less than background concentrations at Hunters Hot Springs. Uranium has only been consistently detected onsite and, with one exception, has been below its MCL.

7. Action: Clarify the contaminants of concern that pose a potential risk to human health.

Basis: Section 2.3.3 of the GCAP states, "Only boron, manganese, sodium, and sulfate are a concern when groundwater concentrations are compared to health-based benchmarks such as health advisories and risk-based concentrations." Section 5.0 of the GCAP states, "on the basis of data evaluated for this report, only four constituents present in the surficial aquifer—arsenic, chloride, manganese, and sulfate—pose a potential risk to human health." These two statements imply that there are six potential contaminants of concern that pose a risk to human health.

DOE Response

All of the above six constituents (along with several others) were identified as constituents of potential concern in the BLRA and all are present in some areas in and around the site in concentrations that exceed either regulatory standards or health advisories (which are unenforceable). However, as discussed above, there are probably multiple sources for all of these constituents and identification of site-related COCs is difficult. The contaminant at and in the vicinity of the site that poses the greatest potential risk to human health is arsenic. Highest arsenic concentrations are found in geothermal waters from the Hunters Hot Spring area. DOE believes that the main reason to identify site-related COCs at this point is for the purpose of long-term monitoring. Because DOE believes that supplemental standards apply to the shallow aquifer in the vicinity of the site, and because ICs prevent the use of this ground water, any monitoring of ground water quality would be considered a best management practice only. The

sulfate plume emanating from the former raffinate pond area on site has historically been considered to represent the extent of site-related contamination, even though there is some question regarding this conclusion. High concentrations of manganese are also present within the sulfate plume and below the former footprint of the tailings pile. As a best management practice, DOE proposes to continue to monitor sulfate and manganese in a limited number of wells. Onsite well 0509 will also be monitored for uranium, as 2003 sampling results indicated ground water here exceeded the uranium MCL. Though the biggest risk contributor, arsenic monitoring is not proposed as on-site concentrations do not exceed ambient levels.

8. Action: Discuss the proposed Lakeview valley hydraulic system model and compare the model to actual site data. Clarify the similarity of a marine sediment setting and the lacustrine sediment setting of the Goose Lake Graben.

Basis: Figure 2-5 in the GCAP is a diagram of a closed basin/arid climatic hydrologic system. The diagram indicates a upward moving hydraulic head under the facility location. However, the cross sections A-A' and B-B' provided indicate that hydraulic head decreases generally with depth, opposite of what is shown in figure 2-5. If hydraulic head decreases with depth, this would support a downward componenet of groundwater flow that may allow for millsite contamination at depth is the water-bearing zones are connected.

GCAP section 2.3.3 states, "It would be expected that natural groundwater from a closed lake setting in that arid western U.S. would have some similarities to that derived from a saline marine sediment setting and would also have naturally high concentration of those constituents." A comparison of Lakeview's lacustrine graben-controlled depositional environment to other lacustrine graben-controlled depositional environments seems more appropriate.

DOE Response

DOE should have compared the Lakeview's lacustrine graben-controlled depositional environment to other such depositional environments along the basin and range province. These are described in the USGS's *Ground Water Atlas of the United States* (HA730-H). As noted in this publication, these systems consist of thick sequences of interbedded deposits that range from clay to boulders. The report also notes that these "...unconsolidated-aquifer deposits generally yield freshwater but locally yield saltwater, especially in south-central Oregon and in coastal areas." This is evidenced in the Lakeview area aquifer where concentrations of chloride and sodium in ground water are higher than concentrations from pore fluids collected from the former tailings pile and raffinate ponds (DOE 1992) indicating some other source of contamination.

9. Action: Provide information showing that the groundwater from potential deep wells greater than 300 feet deep within the IC boundary are not hydraulicly (*sic*) connected to contaminated shallow groundwater.

Basis: Domestic wells will be allowed in the IC boundary at a depth greater than 300 feet (or whatever the Oregon Water Resources Department codifies). If the deep aquifer water-bearing zone and the shallow aquifer water-bearing zone are hydraulicly (*sic*) connected, there is a possibility that a domestic well may draw contaminated groundwater from the shallow water-bearing zone into the deep water-bearing zone. DOE has not demonstrated that the shallow aquifer and the deep aquifer are not hydraulicly (*sic*) connected.

DOE Response

DOE does not have any empirical data to demonstrate that wells greater than 300 feet deep are not connected with shallower water-bearing units. However, based on data in the environmental assessment (DOE 1985) and the remedial action plan (DOE 1992), the practical depth to which surficial contamination could migrate was judged to be 70 feet or less. This is based on the extremely heterogeneous nature of the subsurface and the presence of numerous interfingering clay layers that prevent significant downward movement of contamination (DOE 1992, 1996b). Units in logs from wells drilled within 20 feet of one another could not be correlated (DOE 1992, 1996b). While data from pump tests indicated some hydraulic connection between shallow (<30') and deeper (>70') units (DOE 1992), the nature of this connection was not straightforward. Water quality from deeper units generally tends to be fairly good, though some isotopic evidence suggests an influence from the geothermal area (DOE 1992). Two deep wells outside the IC boundary (0557 and 0558) have relatively good water quality. While DOE has not drilled a well to 300 feet inside or outside the IC boundary to ensure water quality is acceptable, knowledge of the hydrogeology in the area is adequate to conclude that this depth would be unaffected by site-related contamination.

10. Action: Determine if deep domestic wells constructed within the IC boundary will be subject to long term monitoring.

Basis: New deep wells installed within the IC boundary should be subject to long term monitoring as is domestic well 0543. The contaminants of concern for sampling and the monitoring frequency should be specified in the GCAP. Although potential new wells in the IC boundary would be deep, DOE has not demonstrated at this time that there is no connection between the shallow and deep water-bearing zones.

DOE Response

DOE does not have any empirical data to demonstrate that wells greater than 300 feet deep are not connected with shallower water-bearing units. However, based on data in the environmental assessment (DOE 1985) and the remedial action plan (DOE 1992), the practical depth to which surficial contamination could migrate was judged to be 70 feet or less. This is based on the extremely heterogeneous nature of the subsurface and the presence of numerous interfingering clay layers that prevent significant downward movement of contamination (DOE 1992, 1996b). Units in logs from wells drilled within

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The State of Oregon approved the depth for the drilling restriction. In doing so they apparently believe this depth is adequate based on their familiarity of the local geologic conditions. Multi-use domestic wells in the millsite area are screened between 280 and 400 ft and all produce large volumes of potable water.

11. Action: Provide a rationale for the location of the IC boundary.

Basis: Section 3.2.1 of the GCAP indicates, "An IC boundary was established around the western part of the former millsite that included land containing and extending beyond probable millsite contamination as defined by the extent of the sulfate plume." Monitoring well location 0518 has a sulfate concentration of 429 mg/L that appears to be above background levels. This would indicate that sulfate millsite contamination is currently beyond the proposed IC boundary. The IC boundary may need to be expanded after the site is further characterized and the groundwater compliance strategy is revised.

DOE Response

The IC boundary is based on the 500 mg/L sulfate isopleth for the shallow ground water. This value is an unenforceable health advisory level. It has been assumed that this reflects the extent of site-related contamination. However, as noted above, the downgradient end of this plume may represent sulfur derived from a geothermal source as opposed to a site-related source based on sulfur isotopic data. As discussed previously, background concentrations are expected to vary throughout the Goose Lake Valley depending on sediment distribution in the subsurface and activities taking place on the surface. Concentrations of sulfate greater than 500 mg/L are observed outside the IC boundary, but are most likely not site related. A taste threshold for sulfate is 250 mg/L (EPA 2004). Drinking water users would likely treat water significantly exceeding this threshold based on aesthetic concerns. DOE believes the IC boundary is adequately protective of any site-related contamination.

12. Action: Provide to the NRC for review a copy of each IC agreement that is part of the compliance strategy.

Basis: Institutional controls are discussed in the text of the GCAP in section 3.2.1 and an IC boundary is shown on Plate 1: Lakeview Base Map with 1994 Photo Base. The GCAP does not contain documents to support the location, specifics, and nature of the

ICs that are part of the compliance strategy. Lake County and the City of Lakeview IC ordinances requiring future land users inside an IC area to obtain hookups from the new domestic water line or to drill a well to a depth that ensures satisfactory water quality need to be submitted to NRC for review. The state code insuring the proper depth of the well may also have requirements for well construction such as necessary well casing and grouting depth. If these details are not in the state code, DOE needs to provide the ordinance or code that governs details of domestic well construction.

DOE Response

Institutional control documents are completed and provided.

A copy of ordinance passed on March 20, 2002 by the Board or County Commissioners, Lake County, Oregon, titled *Ordinance No: 10WW-02, Restricted Groundwater Use Overlay Zone* is attached.

Also attached is ordinance No. 785 passed on March 12, 2002 by the Town of Lakeview, Oregon, titled *Restricted Groundwater Use Overlay.*

A copy of the Oregon Water Resources Department ruling *Request for Adoption of Rule to Establish Special Area Well Construction Standards, OAR Chapter 690, Division 200* with the final publication in the *Oregon Secretary of State Oregon State Archives, Section 690-200-0028 (1) Special Area Standards for the Construction and Alteration of Water SupplyWells in the Lakeview Area,* published on April 1, 2004, that limits access to ground water above 250 feet is also attached.

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