THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Department of Environmental Quality

LAND QUALITY DIVISION

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CHEYENNE, WYOMING 82002

MEMORANDUM

TO: Governor Ed Herschler

FROM: Robert E. Sundin, Director, Department of Environmental Quality Robert E. Sundin
Roger Shaffer, Administrator, Land Quality Division Roger Shaffer

DATE: July 1, 1985

RE: Status of Work on the Riverton Tailings Project

Our staff has finished reviewing the documents obtained from the Department of Energy (DOE) at the end of March as well as the recently updated hydrology study of the Riverton site. Based upon our meetings with DOE and their contractors and review of the documents, it is our recommendation that the tailings be relocated rather than stabilized in place. The technical basis is outlined in the four points below. Staff reviews are attached for your information.

The Nuclear Regulatory Commission has also met with the DOE and reviewed the documents. They have voiced concerns similar to the ones we have raised.

1. Encroachment on the tailings site by the Big Wind River is likely. The encroachment is caused by aggradation of the river channel, shifting in the river's meander pattern, and reactivation of old cutoff channels in a flood event. Evidence strongly indicates that river encroachment will occur within 100-500 years.

2. The current location is highly prone to destruction by flood over the long term. The analysis used by DOE in determining flood flow for the site grossly underestimated the flood risk. The potential for designing an engineered structure which would withstand flooding and river encroachment for the required time interval is low.

3. Stabilization in place does nothing to alleviate the current groundwater contamination, but could serve as the source of continued contamination. The evidence presented indicates that migration of the contamination from the surficial aquifer to the more important confined aquifer has occurred and will continue.

4. Engineered structures placed on site could not prevent damage and possible mobilization of the tailings caused by flood, river encroachment or structural instability caused by saturation of the tailings. Thus, the standards for long term stability probably cannot be met if the pile is stabilized in place.

Other Information Concerning the Riverton Project

The public hearings held May 29 and 30 by the Smalley Committee at St. Stephens, Riverton and Hudson received moderate attendance. Representatives Tippetts and Odde as well as Senator Ninich were Fremont County's legislators present at the Riverton hearing. Representative Ratliff attended the Hudson hearing.

The comments made by those who attended the hearing were diverse. The most common question raised during the hearings concerned defining the current health risks associated with the site. Several individuals asked what effects the tailings may have already caused as well as what effects might be realized in the future. Residents of the Wind River Reservation expressed concern at leaving the tailings in place and recommended their removal as did a representative of the St. Stephen's Mission. Niles Andrus of American Nuclear made his offer public for using their licensed tailings site as a repository for the Susquehanna tailings at the St. Stephen's hearing. An individual who lives near the tailings site expressed her desire to have them relocated. Others who were past workers in the Uranium Industry questioned the cost effectiveness of removing the tailings. Other questions ranged from defining the legal aspects of obtaining the Riverton site to inquiring whether land around the site could be purchased to keep the general public and the tailings separated. It should be noted that only a few people at the hearing dominated the discussion. Specific details concerning all the discussion at the hearings are available upon your request.

On May 17, the Department received a proposal from the American Nuclear Corp. for placing the Susquehanna tailings in their Gas Hills tailings facility. The proposal was conceptual in scope and involved placing about 1,100,000 cubic yards of tailings in American Nuclear's tailings pond number one.

At this time we have an estimated 643,000 cubic yards of tailings on the surface at the old Susquehanna site. We do not have a clear picture of the volume of subsurface material that is contaminated and would require removal. A conservative estimate of the total volume that would have to be handled is 1,500,000 cubic yards. Preliminary analysis indicates that the American Nuclear site could handle this volume and still be reclaimed to a surface configuration similar to the current Nuclear Regulatory Commission, Department of Environmental Quality approved reclamation plan. More than an ample volume of material for cover is available close to this site. This material has not been tested concerning reclamation suitability as yet.

The hydrologic regime of the American Nuclear area appears to be suitable but further study must be conducted in this area.

Rough cost estimates have been obtained from three contractors for removing 1.5 million cubic yards of tailings and contaminated soils, hauling the material to the American Nuclear site, placing it, and covering it with six feet of material. These costs ranged from $10,500,000 to $18,600,000. Additional costs would be realized in instituting a radiation safety plan, reclaiming the old Susquehanna site, constructing water treatment impoundments and the other incidental work that is required. These costs have yet to be worked up.

The latest cost from the DOE Contractor is $10,570,000 for stabilization in place and $17,990,000 for relocation to the dry Cheyenne site. We are unable to determine from the DOE material if the additional costs mentioned above have been included.

In summary, the four points stated at the beginning of this memoranda, and the following additional ideas, we recommend the tailings be relocated.

The taxpayers would only pay for NRC monitoring of one (1) less tailings site. The concerns from the tribes and people in the area about stabilization at the existing site would be mitigated.

RES/RS/LA:mm

xc: Lynn Askew - Lander DEQ/LQD, District II

MEMORANDUM

TO FILE : UMTRA, Riverton Tailings Project

FROM : Lynn Askew, Environmental Specialist, Riverton Project Manager

DATE : June 6, 1985

SUBJECT : Review of Revised Hydrology Appendix for Draft EA; Recommendations for Remedial Action

My review of the revised Appendix D of the Draft Environmental Assessment indicates that numerous hydrologic concerns exist in regards to the proposed preferred alternative of stabilization in place. My comments are listed below. In light of my review, it is my recommendation that the tailings be relocated and not stablized in place.

1. Geomorphic Hazard

The geomorphic hazards associated with the tailings pile's proximity to the Big Wind River have been largely ignored in the revised Appendix D.

a. The discussion of meander hazard associated with the Wind River on page D-16 of the revised Appendix D is misleading, given the meander rates shown in the Sergent, Hauskins and Beckwith geomorphic evaluation. In addition, the distance of one mile from the Big Wind River to the tailings pile shown on page D-16 is erroneous. This distance ranges from 3,400 feet at its closest proximity to 4,000 feet at its furthest (see figure D.1.2.). The meander shift rates given in the Sergent, Hauskins and Beckwith report ranged between 9 and 32 feet/year. Using the lowest figure of 9 feet/year, it would take less than 380 years for the river to reach the tailings site. If the mean figure of 20 feet/year is used, it takes 170 years for the Big Wind River River to reach the tailings. These figures are substantially less than the times eluded to in the revised Appendix D. They also are substantially less than the EPA design criteria of 200-1000 years for stability.

b. The discussion of aggradation rates on page D-16 totally ignores the results of the Sergent, Hauskins and Beckwith (SHB) evaluation. The SHB evaluation conservatively estimated an aggradation rate of 5 feet/100 years. The current low flow level of the Wind River is five feet below the tailings site elevation. Thus, it appears that aggradation could cause river encroachment in 100 years, one-half of the minimum stability requirement. Further, Appendix D states merely that aggradation caused by Boysen Reservoir is "difficult to predict." Yet, the SHB evaluation states that aggradation caused by the reservoir leading to encroachment on the site is possible in less than 1,000 years.

c. The SBH report states that in the event of flood or aggradation any of the old paleochannels could be reactivated. Revised Appendix D fails to consider this situation entirely.

d. The SBH report gives an overall assessment of geomorphic risk. The evaluation listed the overall risk as high for river encroachment within the next 200 years and extreme for the period 200-1000 years, yet these risks are ignored in Appendix D.

2. Flood Analysis

a. The PMP was based on a 72 hour storm duration. No consideration was given to a large scale rainfall event on a heavy snowpack. Historical flood data from input watersheds of the Big and Little Wind River systems show that the largest flood magnitudes are associated in response to rainfall/snowpack events. Larger flood peaks may arise from this situation.

b. The soil infiltration rate used in the analysis was 0.5 inches per hour. This in fact may be the instantaneous rate for some soils in the watershed, but this rate falls drastically with time after precipitation begins. Data collected by the Soil Conservation Service on soils in the Wind River watershed indicate that sandy soils show an infiltration rate of .1 to .3 inches per hour shortly after precipitation began. Many of the soils of the Wind River basin are poorly drained. The infiltration rates for these soils are an order of magnitude less than the sandy soils. Much of the higher elevation areas are rock outcrops where no infiltration will result.

Since infiltration is one of the most sensitive parameters of the computer model used in the analysis, the erroneous soil infiltration figure will cause much lower flood peak.

c. The cross-sections used to derive the stage-discharge relationships, velocities and lag times are based on USGS 7½ minute quadrangle maps. These maps have a minimum contour interval of 20 feet. Given the facts that little relief exists in the channel area examined and the mapping contour interval was large, the usefulness of the inputs derived from the cross-sections is questionable. Thus, the lag times and velocities derived from these cross-sections, which are integral in obtaining design specifications, are questionable.

d. Flood water depths flowing adjacent to the tailings pile will result in saturation of the tailings from both flood water and elevated groundwater conditions. When flood velocities are exerted on the pile, the saturated conditions most probably would lead to structural degradation. In addition, these saturated conditions would lead to increased levels of contamination entering the groundwater system.

e. The current site of the tailings is prone to fluctuating groundwater levels and flooding. Any design employed to stablize the tailings in place would have to be flawless and risk free to insure that the 1,000 year stability criteria could have a reasonable chance of being met. In light of the risks and analytical problems previously mentioned, it is not likely that the EPA requirements in regard to stability can be met with stabilization in place.

3. Groundwater and Geochemical Hazards

a. Stabilization in place will do nothing to alleviate contamination to the groundwater system. Rather, over the long term, it provides an avenue for continued contamination.

b. Evidence of communications between the surficial and confined aquifers exists in the data provided. (Page D-204)

c. The long term buffering capacity of the material underlying the pile has not been proven.

d. No one map shows all of the wells used in studying the area's groundwater. The Dept. of Energy seems to dismiss questionable wells rather than conducting further testing or assuming they may have validity.

e. Effects from fluctuating levels of groundwater into the tailings from irrigation must be quantified. This situation has been dismissed from evaluation.

LA:mm

xc: Roger Shaffer - Cheyenne DEQ-LQD

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CHEYENNE, WYOMING 82002

M E M O R A N D U M

TO: Roger Shaffer, Acting Administrator

FROM: Susan Hogg, Hydrologist

DATE: May 24, 1985

SUBJECT: Riverton Mill Tailings UMTRA Project

CHECKED BY:

Introduction

DOE submitted responses to LQD technical comments April 30, 1985. On April 22, the revised hydrology appendix (Appendix D) to the Draft Environmental Assessment document was also reviewed. This memo reviews hydrology issues in both documents.

Discussion

All concerns relating to previous comments that myself and Bill Kearney made have been adquately addressed. The following are remaining concerns arising from review of Appendix D to the EA "Hydrology."

a) Surface Water

1. The effect of utilizing Borrow Site 2 on the flow paths in the event of flooding should be addressed.

2. The control standard requires that the control should be effective from 200 to 1000 years.

   (i) The geomorphologic investigations reveal that aggradation on the Wind River is likely to affect the site in less than 1000 years.

   (ii) The effects of Boysen Reservoir causing upstream aggradation could be felt in 400-800 years.

   (iii) The overall potential of river encroachment on the site is "moderate to high" during the next 200 years and "high" during the next 200-1000 years.

Given the above standard, it is apparent that stabilization in place will not meet the UMTRA requirements.

3. Flood calculations indicate that for stabilization in place, the pile would be required to be designed to withstand a flow depth of 10 feet at a velocity of 15 feet per second. It is doubtful that this design standard could be met with any great degree of confidence.

Groundwater

1. The potential still exists for groundwater to migrate up into the tailings pile.

2. Pump tests conducted are inconclusive since they were not conducted for a sufficiently long time period. Water quality data indicates, however, that the unconfined and the confined aquifers are intercommunicating. This increases the potential for further contamination.

3. It is not clear why the flood events discussed could not cause groundwater inundation into the pile. Bank storage and groundwater flow interactions should be fully investigated.

4. Background water quality has been poorly defined. For the unconfined aquifer, only single samples from four different wells were utilized. Multiple samples from each well should be utilized to properly determine any seasonal trends. Although more samples were taken to define background in the confined aquifer, it is recommended that at least 4 samples per well be utilized (all taken at different times of the year).

5. On page D-229, figure numbering is incorrect.

6. In the final analysis, the impacts of various remedial action plans to the groundwater system are addressed. Results are summarized as -

   (i) No action - cleanup occurs in approximately 65 years (pD-281)

   (ii) Stabilization in Place - cleanup occurs in approximately 65 years (pD-284)

   (iii) Relocation - cleanup occurs in approximately 45 years (pD-278)

   (iv) Slurry Wall - no cleanup for as long as 300 years (pD-290)

It is apparent that the "stabilization in place" option and the "no action" option effectively result in the same impact environmentally in terms of groundwater. In consideration of costs involved, it would not be prudent to stabilize in place. Relocation of the pile 'buys" 20 years of time i.e. no contamination

in place. Relocation of the pile "buys" 20 years of time i.e. no contamination can be expected 20 years earlier at the Riverton site.

7. With regard to the Dry Cheyenne site, further drilling should be conducted to determine groundwater conditions at the site rather than relying on data 2 1/2 miles away.

Conclusion

Given the above considerations, the following conclusions can be made with regard to hydrology issues:

1. Stabilization in place will probably not meet the UMTRA standards.

2. Stabilization in place with respect to groundwater contamination will have the same effect as no action at all.

3. Relocation will "clean-up" the site 20 years sooner and it appears will have little or no impact at the relocated site - more data is necessary, however, to verify this. Also, other relocation sites should be considered.

SH:jls

cc: Lynn Askew, District II
Bill Kearney
Tim Richmond

/HOGG MEMO/

MEMORANDUM

TO: Lynn Askew, DEQ Riverton UMTRA Project Coordinator

FROM: Kate Laudon, WQD Groundwater Engineer Evaluator KJL

SUBJECT: Water Quality Division Review Comments for the Revised Hydrology Appendix to the Environmental Assessment (EA) for Remedial Action at the Riverton, Wyoming Inactive Uranium Mill Tailings Site

DATED: June 6, 1985

John Wagner and I have reviewed the revised hydrology appendix for water quality aspects of the surface water and the groundwater in the vicinity of the Riverton UMTRA site. The hydrology appendix addresses three major areas of concern which will affect the decision of whether the tailings should be stabilized in place or moved to another site.

The first major area of concern addressed in the report is the potential for flooding of the site and the associated affects on the structural stability of the reclaimed tailings pile. The Riverton tailings site is situated on an alluvial terrace that forms the drainage divide between the Wind River located approximately 3/4 mile north of the site, and the Little Wind River located 0.5 mile southeast of the site. The confluence of the two rivers is approximately 2.5 miles northeast of the site. Geomorphic data contained in the hydrology appendix indicate that the potential for flooding of the site exists, principally from the Wind River. Aerial photographs have been studied, and show paleo-channels from the Wind River on or near the tailings site. The report also indicates that the main channel of the Wind River could migrate laterally across its floodplain toward the tailings site. The time-frame involved appears to be open ended. The report states that the rate of migration could exceed 0.5 miles per 1,000 years.

To evaluate the need for long-term flood protection, the report predicts the magnitude and potential impacts resulting from a Probable Maximum Flood (PMF) event. The Department of Energy (DOE) feels that the PMF represents a "maximum credible event" and has a very small chance of being exceeded. Therefore a tailings disposal system designed to withstand "maximum credible events" would have a very small risk of failure, and would meet the intent and long-term containment objectives of the EPA standards for the control of uranium tailings.

The model predicts that a PMF of approximately 403,000 cfs on the Wind River would result in water depths of approximately 10 feet along the sides of the pile and mean channel velocities of less than 15 feet/sec. The report also predicts that an erosion protection barrier placed around the pile and designed for 10 foot depths and 15 feet/sec velocities would adequately protect against the PMF.

The revised appendix does not address some additional concerns of ours that have been raised in past meetings with the DOE, and in the initial review of the draft hydrology appendix.

1. A number of variables were used as input data into the geomorphic model used to calculate the PMF, including probable maximum precipitation that would occur over the drainage basin, hydrograph time interval, soil infiltration rate, lag times for each drainage basin, and cross-sections of channel reaches forflood routing. No sensitivity analysis of the model to the various parameters was performed. Rather, one single "conservative estimate" is presented. Considering the size and variability of the drainage area involved, and the complexity of the configurations of the two rivers in the vicinity of the tailings pile, a range of flood flow discharges, flow depths, and velocities should be presented representing sensitivity of the model to changes in the different variables.

2. The PMF has been calculated based on a PMP event 72 hours in duration. Historically large magnitude flood events in Wyoming occur in response to rainfall events combined with spring and summer snowmelt. The appendix addresses this concern on page D-26 with the statement that "at present, the report does not address a spring PMF with snowmelt."

3. Water depths of 10 feet adjacent to the pile could result in saturation of a significant amount of tailings material within the pile. As the flood waters receded, and this water drained from the tailings, significant levels of contamination would be released into the groundwater.

The second major area of concern addressed in the appendix includes the existing water quality in the vicinity of the site, and the tailings pile as a source of contamination. The characterization of existing conditions is based on surface water samples collected from both rivers, and irrigation ditches around the site, pore water samples collected from the tailings pile, and groundwater samples collected from wells completed in the shallow alluvial aquifer, and the deeper confined aquifer.

The alluvial aquifer in the vicinity of the tailings site is approximately 20 feet thick, with a saturated thickness of about 14 feet. Figure D.2.22 indicates that on the eastern side of the pile, the tailings extend below the water table.

A confined aquifer system occurs in the lower sandstone units of the Wind River Formation. Several domestic and stock wells are completed in this confined aquifer in the vicinity of the site. Even though the formation strata are lenticular, interfinger, and vary in thickness, the entire stratigraphic sequence behaves as a single aquifer on a regional scale in response to long-term hydraulic stresses.

As part of the site characterization the potential for downward movement of contaminated water from the unconfined aquifer was assessed. The results of two 24 hour pump tests were inconclusive. An attempt was made to correlate the activity of radiogenic tritium in samples from wells completed in both the alluvial aquifer, and the confined aquifer. The hydrology appendix concludes "that the high tritium concentrations observed in the first and second confined sandstone layers may be the result of sampling or analytical error" and the results of the tritium analysis should be considered inconclusive. On pages 53-55 of the document entitled "Responses to Wyoming Department of Environmental Quality RAP and EA Ground-Water Comments" it is stated that "the consistency between predicted and observed tritium levels suggests that the downward leakage mechanism may be a feasible explanation for significant tritium accumulation in the confined system. The mixing algorithm results imply that, over a long period of time under conditions of downward gradient and a measurable conductivity in the confining shale layer, tritium as well as chemical contaminants may be advected and dispersed into the confined system from the overlying alluvium.

Data from a number of wells have been used to document contamination of the alluvial aquifer downgradient of the tailings pile. Figures have been prepared which illustrate the configuration of contaminant plumes of sulfates, uranium and molybdenum trending from the tailings pile toward the river. Figure D.2.26 which represents the sulfate plume is misleading. The concentrations presented in figure D.2.26 apparently were measured in the summer and fall of 1982, although not all the values are contained in Table D.2.22. Sulfate levels in most wells measured since 1982 have increased significantly over the values presented on the figure, yet this figure is supposed to represent existing conditions at the site, and these data were used as input to the geochemical model used to predict the behavior of sulfate in the alluvial aquifer.

This figure does represent the mechanism that exists for the transport of contamination from the tailings pile to the Little Wind River. A steady-state simulation of flow in the alluvial aquifer calculated that the seepage of contaminated groundwater into the Little Wind River occurs at a rate of approximately 39 ft^3/sec. Two samples collected by DOE upstream and downstream of the tailings site indicate no increase of uranium or sulfate in the Little Wind River.

A number of the samples that have been collected at the site are not included in the hydrology appendix because they were assumed to have been subject to sampling or measurement error. The table that lists these samples has been omitted from my copy of the appendix. This information should be included in the appendix, as it may represent a substantial portion of the data base for the site.

Based on data used to characterize existing conditions at the site, several geochemical transport, and groundwater flow models were used to simulate existing conditions and to predict future behavior of groundwater contamination associated with the site.

Sulfate was used as the geochemical constituent to define existing conditions at the site. The behavior of the sulfate plume was used in the impact analysis to evaluate various groundwater protection strategies. Groundwater protection alternatives include relocation to a more inocuous location, stabilization in place, the installation of low permeability covers and liners, slurry wall emplacement, or no action.

The effects of relocation of the pile, and stabilization in place were both modeled based on the same input of contamination to the aquifer, resulting in identical long term contamination behavior. The similarity of plume development was attributed to the negligible contribution of infiltrating water to the overall water balance within the aquifer.

Realistically, removal of the tailings pile would eliminate any source of contamination to the aquifer. If the pile is stabilized in place, it will act as a continuing source of contamination due to the release of residual pore water associated with compaction of the pile, and to the release of additional contamination associated with periodic inundation of the pile by flooding, or high groundwater. Rather than contamination dissipating in the aquifer as is implied in the model, sulfate concentrations may be increasing as indicated by the most recent sampling data. Other data included in the appendix indicate that the potential exists for the contamination of the lower confined aquifer by water moving from the upper alluvial aquifer. Some data suggest that this may have already occurred.

KL/jw
copy: Bill Garland, John Wagner,
Jake Strohman, DEQ/WQD, Cheyenne
Steve Gerber, DEQ/WQD, Lander