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Return to URFO/Denver

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Hydrogeology • Mineral Resources Waste Management • Geological Engineering • Mine Hydrology

40-8084

August 31, 1983

Dr. Harry Pettengill
Uranium Resource Field Office
U. S. Nuclear Regulatory Commission
P. O. Box 25325
Denver, Colorado 80225

Dear Harry:

I have enclosed my report and recommendations on Rio Algom's groundwater contamination problem. Please call if you have any questions concerning my review.

Sincerely,

Roy

Roy E. Williams
Ph. D. Hydrogeology
Registered in Idaho

REW:sl

enclosure

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DRAFT

A Report and Recommendations to
Dr. Harry Pettengill, URFO, NRC, on
Rio Algom's Groundwater Contamination Problem,
by Roy E. Williams,
September 1, 1983

My review of Rio Algom's groundwater contamination reports and data have yielded the following information and recommendations.

A. North Side of Ponds

1. Ten new holes (RW9A, RW6, RW15) have been drilled 50 feet apart in a line 220 feet south of MW7. The line of wells runs northeast-southwest, not parallel to the Rio Algom property line which runs eastwest. The line does not cross the property line. A cross section was drawn showing topography on the Brushy Basin and the water table. All wells showed a thin layer of seepage over a hump on the Brushy Basin. The hump slopes north, west and east from MW7. The saturated section here is 3 feet thick. These wells can be pumped dry in a few minutes at <2 gpm with a small submersible. A pumpback system here won't work; not enough saturated thickness exists to achieve sufficient available drawdown.

2. A second east-west cross section between well MW7 and the ponds from well H72 (and RW5) through well RW2 (no new wells) shows the Brushy Basin and the water table sloping eastward and westward as well as north. Well H72 has no water above the Brushy Basin, so seepage moves north preferentially to the west.

3. A third east-west cross section drawn immediately north of the ponds (FT1 through H48) shows the water table dipping steeply westward from a point located directly north of the center of the lower dam (well GW10). GW10 is on the edge of the valley (on the edge of the fault zone?). The section becomes complex once the edge of the valley is encountered. Well GW14 is in fact dry even though it is only 30 feet west of observation well 71. GW14 is at a depth of 6459 (dry). Observation well 71 is bottomed at 6466 feet. Elevation of water is 6498 in observation well 71. Well GW15 is located 200 feet east of observation well 71 and it has water cascading downward from elevation 6556 to 6495 as determined by an electric probe. This may indicate that once the fault zone beneath the valley is encountered perched water occurs in the section. The perched water would not be seepage and it would confuse water level readings and water quality readings. It would make them very difficult to interpret.

4. New wells called LT1 through LT9 (LT = lower tailings) were drilled to the Brushy Basin north of the lower tailings dam. These wells are all low yield (<3 gpm) except for LT3 which might yield 8 to 10 gpm. Some have water quality indications of seepage and some do not. They indicate that the system is heterogeneous with respect to both water quality and yield. They indicate also that the top of the Brushy Basin is not a consistent sharp contact. It must have been an old erosion surface with stream channels on it prior to the deposition of the Dakota-Burro Canyon sandstone on top of it.

   The water levels in these wells suggest that a minimum of about 50 feet of unsaturated material may underly the upper tailings pond.

5. A review of water levels in the piezometers in the upper embankment revealed that they have never contained water. Their construction records show that they are bottomed in or on the sandstone immediately under the embankment. This suggests also that an unsaturated zone exists beneath the upper pond.

   These two pieces of evidence suggest that pumping the mound under the upper pond will not increase the seepage rate out of the pond because the mound under the upper pond apparently has not yet reached the bottom of the pond. Consequently if a high yield contaminated well can be located and pumped at 20 or more gpm it should not increase the seepage rate from the upper pond. This constitutes a new piece of evidence in the jig saw puzzle. Previously in the absence of data we have assumed that the mound is in contact with the pond. Therefore pumping near the pond would have increased the seepage rate.

6. Bob Pattison has by accident discovered that a recently drilled observation well (observation well 9) may constitute a well that can be pumped at a high rate (≧20 gpm). This well is heavily contaminated also. It is located about 800 feet north of the center of the upper tailings dam about 650 feet from the north edge of the upper tailings pond.

7. Recommendations

   All the above comments and this recommendation apply to the seepage plume extending northward. This recommendation is based on the following assumptions and interpretations.

   a) Seepage on the north side of the pond is independent of seepage on the south side of the ponds, i.e. the ponds have created a ground water divide.

   b) Seepage movement is toward the north, northwest and northeast but the primary exit route is along a valley in the surface of the Brushy Basin that extends north and northeast from the upper pond.

c) A fracture system extends through observation well 9 as indicated by the aforementioned pumping experiment. This is a critical assumption which at present has only a limited data base.

Observation well 9 is a 6 inch diameter open hole with 20 to 25 feet of saturated thickness above the Brushy Basin. I recommend that an attempt be made to pump this well via the open hole, without further development at the maximum rate permitted by a pump that is installable in a 6 inch hole (about 20 gpm). The water level in the pumped well (observation well 9) and in the surrounding wells should be monitored. The well should be pumped for at least a week at a constant rate of about 30 gpm if it does not dewater. If it does dewater the maximum sustainable pumping rate that will draw the water level down to a foot or so should be determined by trial and error. If the well does not dewater the water levels in the pumping well and in the surrounding wells should be measured as often as possible, every 20 or 30 seconds during the first hour of the test. Measurements should be made about every 2 minutes during the second hour of the test. Measurements should be taken every 5 minutes during the third hour of the test. Measurements should be taken every 10 minutes during the fourth hour of the test. During the fifth hour of the test readings should be taken every 30 minutes. Readings should be taken once per hour during the next 2 hours. This completes one 8 hour shift. Thereafter readings can be taken once every 4 hours and ultimately once ever 8 hours for the duration of the test. The test should last for about a week. The resulting data will provide a basis for determining the properties of the fractured aquifer so that predictions of its behavior under various pumping rates over various time periods can be determined. The data also will tell us whether or not and in what time period the pumping of observation well 9 can be expected to withdraw seepage from the north plume. Particular attention should be paid to well GW20 because preliminary data suggest that it may yield as much as 12 gpm; it is of poor quality. It may be advisable to pump it at a later date depending on its reaction to the pumping of observation well 9.

B. South Side of Ponds

1. Three new wells (FT2, 3 and 4) have been drilled in a line directly southwest of existing wells H49 and H14. A cross section has been prepared using these 5 wells. The section shows alternating sands and shales along the Lisbon fault south of the ponds. The top of the Brushy Basin is not so easily defined in the valley south of the pond as it is north of the pond. The section shows the water table to be nearly flat toward the south from well H49. It is at an elevation of 6548. This water table drops abruptly northwestward to elevation 6510 feet at the location of MW12 (a distance of about 1200 feet (gradient = .04). Thereafter it remains nearly flat toward the northwest for a distance of about 2400 feet.

2. As suggested above, water levels in wells MW1, MW2, MW11 and MW12 suggest a nearly flat piezometric surface south of the mound under the lower tailings pond. However water levels in dam piezometers D3, P9 and P4 indicate that the water table is about 2 feet below the bedrock surface but that there is a vertical gradient downward. These data can be explained in several ways, none of which can be verified with existing information. The nearly flat piezometric surface can be caused by a partial barrier that restricts flow toward the northwest in the fault controlled valley south of the pond or it can be caused by a restriction in flow vertically downward in the valley, or a combination thereof. We have no vertical gradient measurements in the vicinity of MW1, MW2, MW11 or MW12 to resolve this issue.

   Regardless of direction of flow or constriction these data suggest that the groundwater mound on the south side of the lower tailings pond is in direct hydraulic connection with the water in the lower tailings pond. There appears to be no unsaturated zone under the lower tailings pond. Therefore a pumpback system south of the lower tailings pond probably will increase its leakage rate because it will increase the gradient between the fault controlled valley aquifer and the tailings pond mound (unlike the upper tailings pond case).

   There appears to be no way to avoid this problem if a pumpback system is to be installed to intercept seepage toward the south from the lower pond. A pump back system should consist of a line of wells along the outer edge of the top of the embankment. It is not possible with existing information to prescribe the proper spacing or the proper pumping rate. But the pumpback wells should be bottomed at elevation 6510 feet; they should be open at least from the bedrock surface to the bottom. The first well should be drilled through the stream channel that lies under the dam. The remainder of the wells should be drilled toward the ends of the dam. Initial drilling should consist of 3 wells. The second and third wells should be located 200 feet east and west of the well through the stream channel. The well through the stream channel should be pumped first at the maximum rate possible (rate unknown) and water levels in the second and third wells should be monitored. If significant drawdown occurs in them the spacing of future wells can be increased. A similar sequence of drilling and pumping experiments should proceed to the ends of the dam.

3. None of the above addresses seepage toward the south from the upper tailings pond. The aforementioned cross section and water quality data (section B1 above) suggest that seepage is reaching wells H49 and H14. But the portion of the upper pond that is leaking southward will be determined by the location of the ground water divide beneath the upper pond (unknown) and the location of the divide on the hump in the Brushy Basin (unknown). Additional wells extending approximately south from the center of the upper dam across the cross section of wells FT3, FT2, FT4, H49 and H14 will be required to answer this question. A pumpback system is not appropriate at this location until this question is resolved.