ATTACHMENT 3

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CONSULTING ENGINEERS

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May 8, 1979

Subject: Response to NRC Requests 362.33, 362.34, and 362.35, Lucky Mc Tailings Retention Project, Gas Hills, Wyoming.

Job No. 5600W

Pathfinder Mines Corporation
Lucky Mc Mine
P.O. Box 831
Riverton, Wyoming

Attention: Mr. Kerry J. Welch

Gentlemen:

As requested, we have performed additional investigations needed for responses to the NRC's requests for additional information concerning the site geology discussed in our geotechnical report for Tailing Dam No. 4. The additional investigations involved field studies at the two faults in question, trenching to expose the reverse fault between Reid and Frazer Draws and air photograph interpretations.

Request 362.33:

NRC Question:

"On Page 11 (Chen report), the first paragraph states that the reverse fault on the west flank of the Dutton Anticline does not affect the Wind River formation and younger Tertiary-age rocks. This is not obvious on the geologic map on Figure 4-2, which shows the fault cutting across Quaternary soils and trending into the contact between these soils and the upper Wind River formation. Additionally, the presence of the narrow, flat crested ridge overlain by coarse granular terrace alluvium, which separates Reid Draw from Frazer Draw, appears to be anomalous. The existence of the ridge, which is underlain by Cody Shale, and Frazer Draw, which has been cut into the Frontier formation, could be explained by differential erosion of the two formations. However, an alternative explanation is that

geologically recent movement has occurred along the reverse fault elevating the ridge between the two drainages. To resolve these questions, provide the evidence that demonstrates that the fault does not affect the Wind River and younger rocks overlying it, thus supporting your conclusion that last movement on the fault occurred at least 60 million years ago."

Reply: In order to further evaluate the suspected reverse fault indicated by Keefer (1970 Plate 3), and shown on Figs. 4-2 and 4-7 of our geotechnical report for Tailings Dam No. 4, trenching was done at several locations along the suspected fault zone. A series of trenches were excavated along the ridge extending to the east of Tailings Dam No. 4. Three trenches were dug across the projection of the fault in the SE 1/4 of Sec. 15. In addition, several backhoe pits, prospect pits and outcrops were examined to obtain structural data.

As a result of our field investigation, it was determined that a reverse fault zone does exist in the general area shown on our Figs. 4-2 and 4-7. Two north trending, subparallel, high angle reverse faults with the eastern block upthrown were encountered along the ridge crest about 650 feet east of the present eastern limit of Embankment No. 4. The fault zone is about 100 feet wide. The western fault strikes N. 10° W. and dips 65° toward the east. The eastern fault strikes N. 10° W. and dips about 55° toward the east. Bedding in the Cody Shale to the west of the fault zone dips toward the northwest between 5° and 30°. Bedding in the Cody Shale on the east side of the fault zone dips toward the west between 60° and vertical. A small overturned anticline was observed in the Cody Shale about 400 feet to the west of the fault zone. Dips measured in the Cody Shale to the west of the fault zone are comparable to dip angles encountered in our core holes drilled for Embankment No. 4.

Three trenches were located across the projection of the fault zone in the SE 1/4 of Sec. 15. Trenching in this area indicates that the fault displacements seen to the north give way to a bedding plane flexure here. The axis of the flexure parallels the western limb of the Dunton Anticline. The axis of the flexure is to the east of the fault trace shown on Fig. 4-2 in our geotechnical report. These trenches indicate that the folding or faulting does not affect the terrace deposits along the divide between Reed and Frazier Draw. This fine, sandy silt alluvium has a soil profile at the ground surface. The profile has a 5-inch thick A_1 horizon, underlain by a 12-inch

thick B horizon showing strong, coarse prismatic structure and weak clay films. The B horizon is underlain by a thick (greater than 40 inches) C_{ca} horizon with stage II development.

In the present study, we found no place along the fault zone where the fault trace is presently overlain by the Wind River Formation or younger rocks. Keefer (1970, Plate 3) shows the fault in question passing from Sec. 15 to the south through the open pit mine. However, the north trending high angle reverse faulting has not been observed in the mine. Our current study indicates that fault displacements do not extend south of Sec. 15. The field conditions require that age evaluation of fault displacement largely be based on regional structural trends and tectonic history of the basin.

As stated in our geotechnical report, we consider that the reverse faulting is contemporaneous with intense Laramide age east-west compressional stress responsible for the formation of the Dunton Anticline. The Wind River Formation in the area overlies the Cretaceous and older folded rocks with a marked angular unconformity. Where exposures are present, it is apparent the Wind River Formation is little affected by the compressional stress which affects the older rocks. Regional geologic work indicates that within the Wind River basin, the compressional stresses associated with the Laramide Orogeny died out in the early Eocene, (Keefer 1970, pp. D8, Table 3). Other workers (Keefer, 1970, pp. D25; Bolster, 1967, pp. C21; & Van Houten, 1964, pp. 85) report that the reverse faulting is associated with the Laramide folding and that only in a few places does Laramide tectonics affect the lower Eocene deposits.

Request 362.34:

NRC Question:

"It is not likely that a fault of the size of the reverse fault shown on Figure 4-2 (Chen report) could have formed without also causing a broader zone of deformation. Such a zone would contain numerous secondary structures such as minor faults and fractures. To insure that such features located within the dam foundation and abutments are identified and properly treated to prevent unstable conditions from developing, the applicant should provide a commitment to geologically map all foundation excavations for the dam."

Reply: The series of trenches along the ridge to the east of Tailings Dam No. 4 indicates that a reverse fault zone is located along the ridge crest about 650 feet to the east of the eastern end of the existing dam. Based on this data and drill cores, it does not appear that the fault zone will extend into the foundation of the proposed enlargement; however, careful and detailed mapping of exposed bedrock surface in the foundation is warranted as construction progresses.

Request 362.35:

NRC Question:

"Figure 4-2 (Chen report) shows an apparent northeast trending fault (inferred fault on Plate 1, Zeller, 1957) cutting across the eastern flank of the Dutton Anticline. According to the legend on Fig. 4.2, the symbol describing its trace is that of a bedding contact. The feature is not discussed in the report. If it is a fault it appears to juxtapose Eocene Wind River rock against Jurassic Cloverly, Morrison, and Nugget formations, and Quaternary soils against the Chugwater (Triassic) and Nugget (Jurassic) formations. Describe this feature in detail and if it is a fault provide the evidence that demonstrates that it is not capable."

Reply: The inferred fault, mapped by Zeller (1956, Plate I) which crosses the eastern limb of the Dutton Anticline in Sec. 1 and Sec. 11 was examined in the field. Evidence of faulting was observed in the form of offset bedding in the Cretaceous and older rocks. A slickensided fault plane is exposed near the crest of the Cloverly hogback near the center of Sec. 11. The fault plane strikes N. 35° E. and is nearly vertical. Slickensides on the fault plane dip 15° toward the north, indicating a large lateral slip component. Offset of beds in the Cody Shale and Frontier Formation indicates a right lateral sense of movement. The fault is about 2 miles long. Its southwestern termination is near the axis of the Dutton Anticline, and its northeastern termination is in the Cody Shale just north of the center of Sec. 1. Maximum displacement along the fault is probably only a few hundred feet, as indicated by offsets of beds in the Frontier hogback. Like the reverse fault between Reid and Frazer Draws, it is our opinion that this fault is a result of compressional stresses associated with folding and is of Laramide age.

The apparent fault contact between the Wind River Formation and older rocks shown on our Fig. 4-2 and taken from Zeller (1956) is incorrect. There is no place along the fault zone where the fault trace is presently overlain by Wind River or where the Wind River is in fault contact with older or younger rocks. The fault is concealed by Quaternary deposits in the draws along its strike. Since outcrops of Wind River Formation do not occur in the vicinity of the fault, it cannot be determined by direct field relationships that the fault has not affected that formation. Our opinions on the Laramide age of the fault are based on its association with compressional stresses and the tectonic history of the basin discussed in the last paragraph of our Reply to Request 362.33 above.

If there are any questions, or if we may be of further service on the project, please let us know.

Sincerely,

CHEN AND ASSOCIATES, INC.

By Ralph G. Mock
Ralph G. Mock
Engineering Geologist

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