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Mr. David Cobrain
New Mexico Environment Department (NMED)
Hazardous Waste Bureau
2905 Rodeo Park Dr. E/Bldg. 1
Santa Fe, NM 87505

RE: Engineering Review of the Evaporation Pond Repair for Western Refining Southwest, Inc., Gallop, New Mexico.

Dear Mr. Cobrain:

Attached please find technical review comments the repair and upgrade work conducted on the evaporation pond containment earth berms at the Western Refining Southwest, Inc. (Western) refinery in Gallup, New Mexico (Site). The attached comments were prepared by our engineering subcontractor, GAI Consultants, Inc. (GAI).

If you have any questions, please contact me at (801) 451-2864 or via email at paigewalton@msn.com.

Thank you,

Paige Walton

Paige Walton
AQS Senior Scientist and Program Manager

cc: Kristen VanHorn, NMED (electronic)
Joel Workman, AQS (electronic)
Cathy Kohler, GAI (electronic)

Enclosure

Engineering Review Comments on the Evaporation Pond Repairs for Western Refining Southwest, Inc., Gallop, New Mexico

1. The stability of the embankment slopes was evaluated by Axis using total stress rather than effective stress analysis methods. Total stress analyses involve less sophisticated (and less costly) laboratory strength test methods than effective stress analyses and were in common usage thirty or more years ago. It has since become clear to the engineering profession that the strength behavior of soil is best characterized in terms of effective stresses, where the pressure of the water within the pores of the soil is explicitly accounted for. In total stress analyses, by comparison, pore water pressures are simply lumped into the soil strength value without quantification. The total stress method, because of the soil testing methodology employed, can potentially involve computations that involve artificially high values of soil cohesion, which, in turn, may lead to falsely high computed factors of safety (FS). Although the stability of the embankment slopes may indeed be satisfactory, that conclusion cannot reasonably be drawn from the data presented by Axis.

   In order to assess whether the stability of each embankment lies within an acceptable range (for example, the FS = 1.5 for long term stability of the downstream face), it is recommended that all stability analyses be repeated using the effective stress method in the context of the Bishop Method or the Morgenstern Price method. This will require retesting the soil materials to determine their effective stress shear strength parameters (φ and c) using, for example, the direct shear method (a drained test) or the triaxial test (a drained test or, alternatively, an undrained test with pore pressure measurement).

2. The aforementioned analyses did not include an assessment of potential seismic loading conditions. A pseudo-seismic analysis should be performed for this purpose. An appropriate peak ground acceleration (PGA) should be applied to determine if the proposed slopes are stable under a seismic load. It is recommended that a PGA (2% over 50 years) of 0.081g based on current mapping be applied. The liquefaction potential of the berm material should also be evaluated.

3. It is unclear how the water level was determined for the Pond 9 north rebuild section. It does not appears that any piezometers were installed in the embankment. In addition, boring logs in the area seem to present conflicting information. The report should provide information on how the groundwater levels were determined for this section.

4. The report does not provide information on how the strengths and unit weights for each soil type were determined, nor does it provide information as to how the delineations of soil materials were determined. Boring logs from 2002 do not have elevations and no lab data were provided concerning the soil material used to complete repairs in 2013 and 2015. The analysis should include this information.

5. The report does not specify whether rapid drawdown will be employed during site operations. If rapid drawdown is expected to occur, then a rapid drawdown analysis should be conducted to investigate the stability of interior slope faces of any pond embankment that

is potentially subject to instances of abrupt lowering of the water level in the pond. Under such circumstances, the rate of dissipation of pore water pressures in the embankment soils, which have developed under long term steady state conditions, cannot keep pace with the lowering of the pond level. This results in excess pore pressures in the embankment that are likely to reduce embankment stability below that of long term steady state conditions.

6. The report does not specify whether loading to the berms is anticipated. Rather, the analyses were run assuming there would be no loadings on the berms (that is, no vehicular axle loadings and no dead loads). Traffic or high loadings on the berms should be included in the analysis if, in fact, such loadings are present.

7. After close examination of the Slope/W runs, the graphical output profile is confusing. Although the output file appears to provide a detailed summary of the specific run, the delineation of materials and zones is unclear. Also, in some runs, the critical failure plane is cut off and not within the limits of the profile. The graphical output must be portrayed at a scale that shows the full profile and is clear and understandable so that the stability of the slope can be confidently evaluated.

8. The following design scenarios should be evaluated in order to determine whether their inclusion would significantly impact embankment stability:

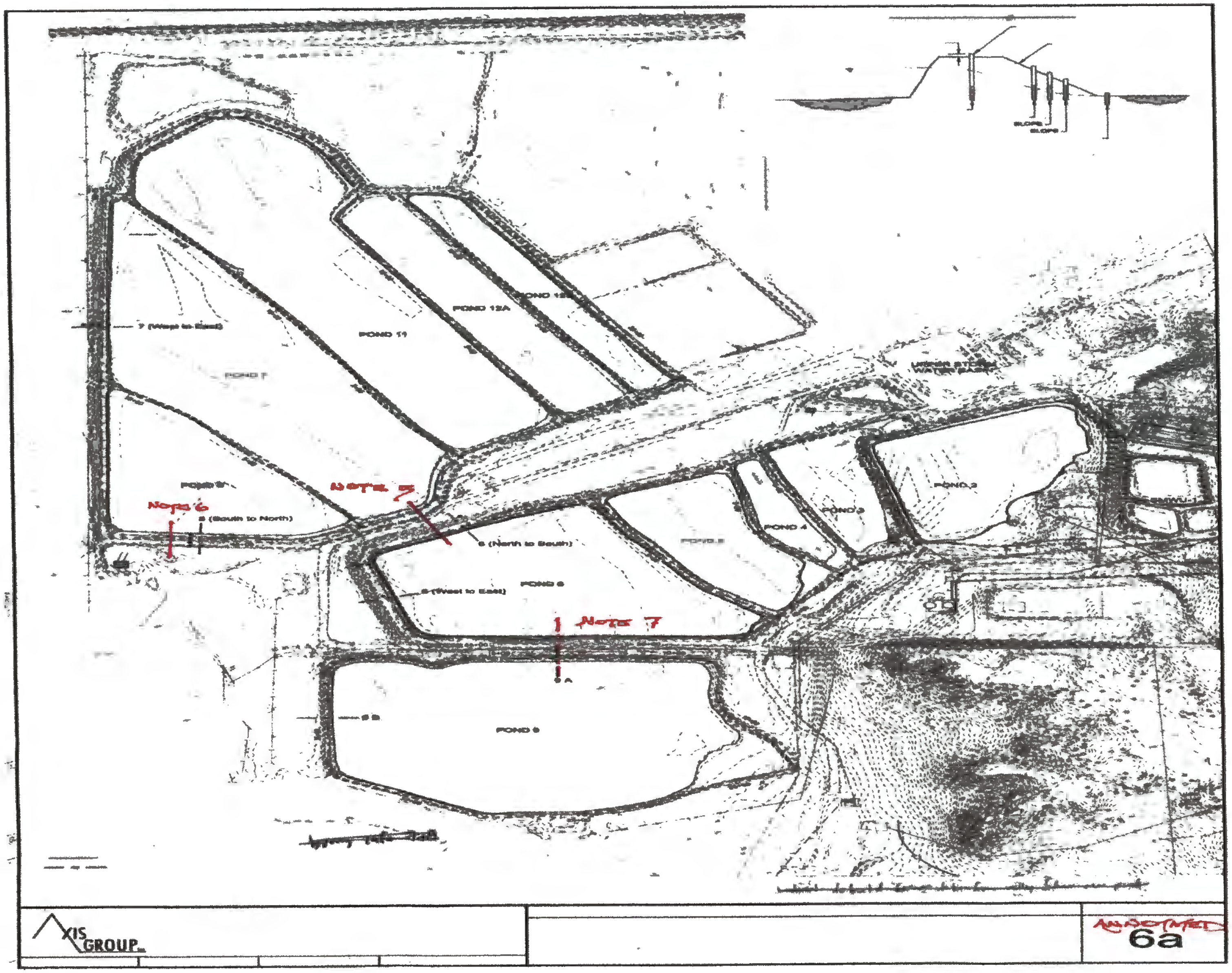
   - Utilize a more conservative estimate of the groundwater elevation through the embankment for Pond 6 (west to east) and Pond 8 (south to north), using the November 11, 2015 readings from Piezometers A and E.

   - In the Slope/W runs, larger entry/exit ranges with more convergence/slip surfaces for each point should be utilized. This would increase confidence that the critical failure surface (that is, the surface with the lowest factor of safety) had, in fact, been identified.

   - The report does not explicitly state why the sections were cut where they were. Therefore, suggest moving Section 6 to the southwest and extending Section 6 into the bottom of Pond 7 to enable a stability analysis of the interior slopes of Ponds 6 and 7, including a surcharge loading (as appropriate). [See Annotated Drawing 6a, note 5]

   - Suggest moving Section 8 slightly to the west to capture the low point of the pond, corresponding to what appears to be the tallest and most appropriate embankment section for the analysis of stability. [See Annotated Drawing 6a, note 6]

   - Suggest extending Section 9A directly north into the Pond 6 bottom, so the stability analysis is performed of the interior slopes of Ponds 6 and 9, with the inclusion of surcharge loads, as appropriate. [See Annotated Drawing 6a, note 7]


POND 11
POND 12A
NOTE 6
NOTE 5
NOTE 7
(South to North)
(North to South)
(West to East)
AXIS GROUP
ANNOTATED
6a