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May 1, 2017

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DCN: NMED-2017-19

NMED
Hazardous Waste Bureau

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

RE: Evaluation of the Responses to Comments on the Engineering Review of the Evaporation Pond Repair for Western Refining Southwest, Inc., Gallop, New Mexico.

Dear Mr. Cobrain:

Attached please find evaluations of the responses to the technical review comments on 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 pwalton@aqsnet.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

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May 1, 2017

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Ms. Paige Walton
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Review of February 17, 2017 Response to Disapproval Letter Report
Evaporation Pond 7 Dike Breach and
Summary Report Evaporation Pond Repairs
Western Refining Southwest, Inc. Gallup Refinery

Dear Ms. Walton:

This letter presents the findings of the technical review performed by GAI Consultants, Inc. (GAI) at the request of AQS, Inc. (AQS) concerning the subject Response to Disapproval Letter dated February 17, 2017. Comments 5 thru 12 were previously provided by GAI to AQS in a letter dated June 3, 2016. GAI has reviewed the responses to these comments and has provided our reply below.

Western Comment Response #5:

Western does not agree that total stress analysis is not applicable in the cases presented in the report. It is acceptable to use the total stress analysis for slope stability for the end-of-construction analysis and for partially saturated soil (refer to "EM 1110-2-1902", USACE 2003, "Geotechnical Engineering Techniques and Practices", Hunt 1986). Based on historical and current soil borings, the soil in the berms is best categorized as partially saturated.

Western updated the previous slope stability work conducted in December 2002 (Appendix C of the report) using the available soil strength data and applied the revised cross-sections after the new berm fill material was placed (through 2015). The updated slope stability work used the December 2002 slope stability triaxial sheer strength data (these were total stress parameters) to estimate the updated factor of safety.

Western used the Morgenstern Price method of analysis in the updated slope stability analysis in Appendix F of the December 2015 report. The updated slope stability analysis conducted on the revised berm cross-sections resulted in increased factors of safety in each updated analysis. The minimum factor of safety calculated for the updated cases was 4.5, clearly in excess of the minimum acceptable factor of safety of 1.5. Note that the effective stress strength parameters on a clay soil typically result in a lower cohesion value (c value) and an increase in the internal angle of friction value. (Ø value) when compared to total stress strength parameters. While there are changes to be expected in the strength parameters between total stress and effective stress, Western does not expect the changes to be significant.

Western will install new piezometers in the downstream slopes of the earth berms along cross-sections that will be used in an updated numerical slope stability analysis. The new piezometers will be installed with casings and bentonite seals above the screen interval to prevent surface water intrusion. Piezometers will be installed at selected cross-sections in the following earth berms:

- **Pond 7/8 west berm;**
- **Pond 6 west berm; and**
- **Pond 9 north berm.**

Due to the slopes and access constraints, the borings used to install the piezometers will likely be hand-augured at each location. Soil samples will be collected using a hand-drive sampler as needed in the hand-auger borings.

The hand-auger will be used to advance a four-inch diameter hole to depths required to install the new piezometer and collect the soil samples. The hand-drive sampler has a barrel that holds brass sleeves for the soil samples. The barrel is driven into the soil and then retrieved. The brass liners are extracted from the barrel, sealed using Teflon™ patches, plastic caps, and tape. Each sleeve will be sealed in the field, labeled as required, and provided to a geotechnical laboratory for analysis.

Soil analysis is expected to include:

- **Soil characterization and classification;**
- **West and dry unit weights with moisture content;**
- **Atterberg Limits;**
- **Sieve analysis; and**
- **Effective stress strength parameters (c′ and Ø′) from a triaxial sheer test.**

The soil data collected from this investigation will be used to update the numerical slope stability evaluation. The cross-sections used in the 2002 and 2015 slope stability work, will be used in the updated slope stability evaluation, with minor adjustments to the locations to evaluate the critical cross section. The following will be incorporated into the updated slope stability evaluation:

- **Morgenstern Price limit-equilibrium analysis via GeoStudio 2012;**
- **Updated berm topography at slope stability cross-sections (through 2016);**
- **Updated phreatic surface based on newly installed piezometers;**
- **Soil properties confirmed during the new geotechnical investigation; and**
- **Effective stress soil strength parameters cohesion (c) and angle of internal friction, phi (Ø).**

GAI Comment 5 Response:

GAI agrees with Western's proposal to collect additional data and use it in updated slope stability analyses. GAI agrees with Western's plan to obtain effective stress soil strength parameters and incorporate them in an updated slope stability evaluation.

Western Comment 6 Response:

The reference provided for a pseudo-seismic analysis is confusing. The reference provided [i.e., 40 CFR §257.74(3)(e)(iv)] appears to be for structural integrity criteria for new CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The CCR referred to in the reference supplied is for Coal Combustion Residuals and does not apply to this facility. Also, the berms are not new and there is no lateral expansion being considered. Based on Western's review of this comment and the citation, a pseudo-seismic analysis is not required or warranted.

In addition, Western does not agree that the liquefaction potential for the berm material needs to be evaluated. Based on observations of the earth berms, there is insufficient flow or seepage at the toe of the downstream slope to require analysis for seepage forces and liquefaction potential.

GAI Comment 6 Response:

A seismic analysis, which includes a liquefaction potential analysis, may be warranted based on the following:

1) If the dikes are classified as a significant or a high hazard potential dam(s) the stability analyses required are outlined in NMAC 19.25.12. GAI recommends that a jurisdictional determination of the dikes be completed by the Dam Safety Bureau to evaluate the applicability of NMAC 19.25.12.
2) "EM 1110-2-1902, Slope Stability", United States Army Corps of Engineers (USACE) 2003, lists "ER 1110-2-1806, Earthquake Design and Evaluation for Civil Works Projects", USACE 2016 (latest edition), as a guide for seismic loading conditions.

Based on these guidance documents, GAI recommends a seismic analysis, which includes a liquefaction potential analysis, be performed for the ponds at Western Refinery. The reference to 40 CFR §257.74(3)(e)(iv) is from the new CCR guidance and was not a proper reference for this scenario.

Western Comment 7 Response:

The Pond 9 north rebuild section is modeling the cross-section from December 2002 slope stability work with no new additional soil or groundwater data.

However, work in 2016 added fill material to the Pond 9 north berm. The numerical slope stability of the Pond 9 north berm will be evaluated using the updated topography and soil strength parameters.

GAI Comment 7 Response:

The updated stability analysis of the Pond 9 north berm should also consider new groundwater elevations from the proposed piezometer in the Pond 9 north berm.

Western Comment 8A Response:

Section 2.4.5 in the Report provides a discussion of soil properties used. As discussed, soil unit weight and strength properties from the December 2002 slope stability analysis were used in the 2015 updated slope stability work. The purpose of the 2015 slope stability work was to update the 2002 slope stability analysis to include the new earth berm geometry. Based on a review of the boring logs and borrow soil sample data, it was determined that the soil classifications were sufficiently similar. Accordingly, the soil and strength properties from the December 2002 slope stability analysis Western were used (i.e., unit weight, cohesion, and internal friction angles). This information was also provided in tabular format in Table 1 of the Report. Average properties were determined for native material and berm fill.

Similarly, the discussion in Section 2.4.5 also indicated that the soil material delineations were based on historic topography and current topography survey data after additional fill material was added to the earth berm slopes.

GAI Comment 8A Response:

Western stated that average values were used to determine the total stress properties of the native material and berm fill. Based on the information provided in Table 1, the average cohesion for the native soil should be equal to 756 psf, not 1152 psf. Based on the soil test results, the strength difference between the soil types used in the model is great enough that the model should represent field conditions as accurately as possible. GAI recommends careful delineation of soil types in the updated slope stability analysis.

Western Comment 8B Response:

Though the boring logs from the 2002 engineering report do not contain elevations, the historic topography was discussed in Sections 2 and 3 and shown in cross-sections on Figure 6b of the Report. The geotechnical data for the December 2002 work was provided in Appendix C of the Report. In addition, geotechnical data from the 2013 and 2015 improvement work was provided in Appendix B of the Report. As shown on Table 1 of the Report, the soil properties do not vary greatly for the berm fill throughout the various earth berm sample locations.

GAI Comment 8B Response:

The report tables should be updated to include the additional data obtained for the revised stability analysis, including the proposed effective stress soil strength parameters to be used for the proposed updated slope stability analysis, as described in Western Comment Response No. 5.

Western Comment 9 Response:

A rapid drawdown analysis is not warranted since Western does not expect a rapid drawdown at the evaporation ponds.

GAI Comment 9 Response:

GAI recommends placing a condition in Western Refining's permit that drawdown rate of water in the evaporation ponds shall not exceed 1 ft/day.

Western Comment 10 Response:

Surcharge loading on the berms is not expected other than occasional light vehicle traffic. Should berm loading beyond light vehicle traffic be required, the loadings will be analyzed as appropriate.

GAI Comment 10 Response:

GAI recommends placing a condition in Western Refining's permit that the only loading allowed on the berms of the evaporation ponds is light vehicular traffic.

Western Comment 11 Response:

The slip surfaces and the phreatic surface in the model output were displayed. However, additional detail will be added on the slope stability output for future slope stability evaluations. The additional detail will more clearly delineate the material type and properties used in each zone. In addition, the cross sections will provide sufficient vertical scale to illustrate the complete theoretical slope stability failure plane. Western expects to provide the updated numerical slope stability evaluation in an addendum to the Revised Summary Report, Evaporation Pond Repairs.

GAI Comment 11 Response:

No additional comment.

Western Comment 12 (1) Response:

The November 2015 water levels from piezometers A and E were used to evaluate the phreatic surface in the 2015 numerical slope stability analysis. In a location where water was not detected, the phreatic surface was conservatively estimated to be at the bottom of the piezometer. Where surface water intrusion was encountered at the toe of the slope, the phreatic surface was estimated to be at the toe of the slope. The water levels used in the 2015 numerical slope stability analysis were obtained from temporary piezometers and that more permanent piezometers will be installed. Data from the new piezometers will be used in the future numerical slope stability analysis.

Please note the following:

- **In Pond 6 North to South, piezometer A (middle of the crest) was dry for the last two measurements and piezometer E was initially dry but subject to surface water infiltration at the toe of the slope from a storm event and, therefore, not reliable.**
- **Similarly, for the Pond 8 South to North section, piezometer A (middle of the crest) was dry for the first two measurements and measured about 1.2 feet of water on the last measurement and piezometer E was initially dry but subject to surface water infiltration at the toe of the slope from a storm event and, therefore, not reliable.**

GAI Comment 12 (1) Response:

Use data from the new piezometers to develop an estimate of the groundwater surface in the future slope stability analysis.

Western Comment 12 (2) Response

In the updated 2015 slope stability analysis, entry/exit ranges were chosen that cover the entire length of the berm. This forced deeper slip surfaces in order to identify the critical potential failure surface.

GAI Comment 12 (2) Response:

Pond 6 West and Pond 9 North rebuild analyses have a critical surface entry point that is located at the limit of analysis. Extend the entry range to cover the entire length of the berm.

Western Comment 12 (3) Response:

Western selected the critical section for each pond system based on geometry, typically in a section with the greatest height for each pond system, and near the locations where the temporary drive-point piezometers were installed. In the future numerical slope stability work, the cross sections will be adjusted as appropriate to address Comment 12.

GAI Comment 12 (3) Response:

No additional comment.

Sincerely,

GAI Consultants, Inc.

Trent I. Muraoka, PE
Project Engineer

John R. Klamut, PE
Engineering Manager

TIM:JRK/djz