KLEINFELDER
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30 March 2007

Mr. Blake Johnson, PE
HDR
2365 Iron Point Road, Suite 300
Folsom, California 95630

Subject: Response to USACE Comment Letter
Levee Reconstruction Project
TRLIA Phases 1, 2, and 4
Yuba County, California

Dear Mr. Johnson:

Kleinfelder has received the USACE response to the Draft Final Construction Completion Report for Three Rivers Levee Improvement Authority (TRLIA) Phases 1, 2, & 4 and Bear River Setback Levee Project Phase 3. In their response, the USACE requested clarification of information contained in Section 3.2.3.5 of HDR's 9 Mar 2007 Draft Final Report. Of noted concern were QC field density test results which recorded moisture contents both wet and dry of the specification moisture content limits. Kleinfelder offers the following response to these comments.

During the design process, selected properties for the compacted engineered fill are established. These properties relate primarily to soil strength and permeability. Other assumptions are made concerning the erosion resistance, seismic ductility, and seasonal maintenance considerations. The degree of relative compaction is usually the most important consideration to achieve these assumed soil properties. However, the influence of moisture content during compaction can also effect the performance of the engineered fill. For typical levee embankment and cutoff wall cap materials which have been compacted to the minimum relative compaction limits, moisture contents above optimum generally result in lower permeabilities, dispersed clay structure less susceptible to seasonal shrink/swell cycles, and a more ductile condition during seismic loading. A maximum moisture content limit is generally established in order to reduce the potential for the soils to become unstable and "pump" under loading of compaction equipment. Stable soil conditions are most important for subgrades for pavements and/or slabs which are subjected to repetitive traffic wheel loading. As the levee embankment is not exposed to this loading condition, stability conditions are not generally critical as long as the minimum relative compaction has been achieved.

Engineered fills compacted at moisture contents dry of optimum generally do not achieve the same benefits to permeability, dispersed clay structure, and ductility. However, these soils when compacted to within the relative compaction specification limits can still achieve the minimum soil properties used in the design.

Senior engineering personnel from Kleinfelder were present during much of the engineered fill placement and compaction operations for this project. Additionally, either a degreed engineer or an experienced field technician was present at the site on a nearly continuous basis to perform QA compaction testing services during engineered fill construction. The Kleinfelder representative was aware of the moisture content conditions and used engineering judgement to evaluate the suitability of the in place soil conditions. Typical factors used in the judgement included:

1. Location of the engineered fill placement. In some cases the moisture conditions which were outside the specification limits were in areas of freeboard or primarily within the outer 2 to 3 feet of the levee embankment. In either of these 2 conditions, it was judged that as long as the minimum specified relative compaction was achieved, either the strength or permeability of the representative test area was not critical to the overall performance of the levee embankment and the conditions were within the minimum soil property design assumptions.

2. Where test results performed by either the QC or QA personnel were outside specification limits, the results were compared and if similar moisture conditions were obtained, the contractor was advised and corrective action was generally taken as indicated in subsequent testing.

3. Field testing personnel used judgment in selecting the corresponding compaction curve for evaluating relative compaction and optimum moisture contents. In subsequent comparisons which plotted dry density and moisture content test results it became apparent in some cases the compaction curve selected for use was likely not specifically representative of the materials tested in the field.

4. Judgment was made concerning the relative accuracy of the moisture content testing method/procedure. It was noted that the samples were retained in sealed plastic bags and returned to the Sacramento area laboratories for testing. Even with diligent care, it cannot be assured that no moisture loss occurred during this process. Additionally, in many

cases the moisture content was outside the specification limit on the order of 1 percent or less. The overall accuracy of the testing process was considered compared to the workability of the material observed in the field at the time of placement and compaction. For the most part, Kleinfelder field personnel are trained to observe the engineered fill placement, moisture conditioning, and compaction process and place some credibility in what is observed in the field versus solely the results of a field/laboratory test.

In summary, based on the field observation by experienced personnel and test results performed by Kleinfelder and others, it is Kleinfelder's professional opinion the engineered fill was compacted in such a manner that the intent of the design assumptions for soil strength and permeability were achieved.

Please contact the undersigned if you have any questions about this information.

KLEINFELDER, INC.

Ray Costa, PE, GE
Consultant to Kleinfelder

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