kpff Consulting Engineers

September 26, 2007

Mr. Tom Hamann, AIA
OTAK
17355 SW Boones Ferry Road
Lake Oswego, Oregon 97035

RE: BLM Little Hyatt Dam – Structural Evaluation
Work Order No. HAD 075M09

Dear Tom:

KPFF visited the site of the Little Hyatt Dam near Ashland, Oregon on September 18, 2007 to review the structural condition of the dam. A geotechnical engineer from Ash Creek Associates accompanied us on this visit to review the foundation conditions. This visit was requested by the BLM to provide a report on the state of the structure and its foundation that identifies structural problems and necessary repairs.

Our evaluation and recommendations are based on new observations made during our September 18, 2007 site visit and in combination with the findings of the *Little Hyatt Dam Engineering Study* prepared by Otak in March 1999, for which KPFF provided structural engineering services as a sub-consultant to Otak.

Ash Creek Associates will provide a separate letter discussing their geotechnical and geologic observations from the site visit.

Summary of Findings

The structural condition of the dam does not appear to have significantly changed since the completion of the 1999 study. The recently observed leaks appear to be the result of an increase in seepage as discussed in the geotechnical reconnaissance letter and the continued deterioration of the concrete structure, both of which are consistent with the findings of the previous study.

The void behind the right abutment was discussed in detail in the previous study and continues to be a concern. This void has altered the load path for the support of this abutment which now relies on the support of the concrete canal wall to prevent it from overturning. If the concrete canal wall deteriorates to the point that it is no longer providing support for the right abutment, the abutment would fail in overturning which would result in sudden failure of the entire dam. We therefore continue to recommend that this void be repaired as soon as possible, restoring the original support load path for the abutment.

If the reservoir is refilled and no action is taken to repair the dam, failure could occur at any time in one of the following two ways (both of which are described in more detail in the 1999 study):

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Seattle Tacoma Portland Eugene San Francisco Sacramento Los Angeles Irvine San Diego Phoenix Denver St. Louis New York

1. The right abutment could fail in overturning and lead to the sudden failure of the entire dam. This overturning failure could result from a loss of foundation support as discussed in the geotechnical reconnaissance letter or from the loss of support from the concrete canal wall. The variable condition and quality of the concrete throughout the dam means it is not possible to predict when the concrete canal wall will deteriorate to the point that it can no longer provide support to the right abutment.
2. Areas of concrete deterioration on both faces of the dam will continue to increase in size and depth until they connect to form holes through the dam. As water passes through these holes their size will quickly increase reducing the storage capacity of the reservoir or potentially rendering it useless if the holes occur low enough on the face of the dam. The variation in the condition and quality of the concrete throughout the dam make it impossible to predict when these hole will occur. However, we believe that the rate of deterioration is accelerating and that the current rate is significantly above the lifetime average for the dam. Failure could occur within a few days of refilling of the reservoir or it may take several years. However, it should be noted this mode of failure is unlikely to cause a catastrophic collapse of the dam, it is more likely that the localized deterioration will cause the dam to drain, relieving the stress on the overall dam structure.

The method outlined in the 1999 study to repair the dam remains feasible and continues to be the recommended improvement if the dam is to remain in place. Except for the repair of the right abutment erosion (recommended above) less extensive repair methods such as patching the areas of concrete deterioration would likely have limited effect of the life span of the dam due to the difficulty in bonding new repair patches to the existing concrete.

The estimated cost to repair the dam in 2007 is approximately $667,000.

Field Observations

At the time of our site visit on September 18, 2007, the water level of the reservoir had been drawn down significantly by BLM crews using siphons and pumps. This allowed us to review most of the upstream face of the dam, however, the leaks reported on the downstream face and at the right abutment had stopped as the water level was lowered and the head pressure decreased or eliminated. (See attached photographs 1 through 10.)

Random soundings of both faces of the dam were taken using a hammer. These soundings generally indicated hard concrete in good condition, however, areas of deteriorated (soft) concrete were found on both faces. These finding are consistent with the field observations made in October 1998 for the previous study.

Photographs contained within the 1999 study were reviewed on site to determine if significant changes had occurred, however, no significant changes were observed.

Where possible, depths of concrete deteriorationthat were listed in Figure 11 of the 1999 study were measured using a steel tape. Generally the depths of deterioration were found to have increased since the previous investigation. This is consistent with the findings of the 1999 study which predicted that the depths of deterioration would continue to increase due to seepage flows and freeze/thaw cycles. (See attached for a copy of Figure 11 from the previous study with current measured depths of deterioration marked-up.)

Recommendation for Repairing Dam

The method for repairing the dam contained in the 1999 study remains feasible and continues to be the recommended improvement if the dam is to remain in place. This repair method could extend the life of the dam by 50 to 100 years and is summarized as follows:

1. Drain reservoir
2. Remove debris and sediment from upstream face of dam.
3. Remove sluice gates and all deteriorated concrete around gates. Fill sluice gate structure and void behind the abutment toe with concrete to form a gravity structure at the right abutment. (Retain an emergency spillway as part of the design.)
4. Install low level drain pipe and control valve.
5. Clean both surfaces and remove all deteriorated concrete on both faces of dam.
6. Patch all deteriorated areas with epoxy grout. Finish upstream face to provide a smooth, sound face for waterproof liner.
7. Install waterproof liner on the upstream face.
8. Remove deteriorated concrete on downstream face and install a new reinforced concrete liner over the downstream face.
9. Buttress downstream toe with riprap to toe erosion from overflow.

Due to the variation in the quality and condition of the existing concrete it is unlikely that a less extensive repair such as patching deteriorated concrete areas would significantly increase the life span of the dam. It would be very difficult or impossible to achieve a reliable and consistent watertight bond between the new patches and existing concrete, and therefore the seepage and freeze/thaw damage would continue to occur rendering the new patches useless within a relatively short period of time.

Cost Estimates

Due to escalation the construction cost estimates for the options recommended in the 1999 study are estimated to have increased as follows:

Option	4th Quarter 1998* ($1,000's)	4th Quarter 2007** ($1,000's)	3rd Quarter 2008*** ($1,000's)
Demolish Dam	$314	$502	$543
Repair Dam	$417	$667	$721

* *Cost estimate based on available data at the time of preparation of the previous estimate with an additional $30,000 based on current understanding of dewatering costs. (Final estimate contained in study includes 4% anticipated escalation to 4th Quarter of 1999.)*

** *Based on an extrapolation of the Oregon Department of Transportation published cost trends for structures which show a 60% escalation in construction costs since the original estimates were prepared in 1998.*

*** *Anticipates and an additional 8% escalation to summer of 2008, if that is when dam might be repaired.*

Please note that these estimates do not include design costs or removal of existing silt from the bottom of the reservoir.

Please call me if you have any questions.

Sincerely,

Craig Totten, PE, SE
Principal

CJT:kw
201190.11/final evaluation letter.docx

Enclosures

PHOTO 1 - DOWNSTREAM FACE OF DAM

PHOTO 2 - DOWNSTREAM FACE OF DAM

PHOTO 3 – UPSTREAM FACE OF DAM

PHOTO 4 – EROSION BEHIND RIGHT ABUTMENT

PHOTO 5 – EROSION BEHIND RIGHT ABUTMENT

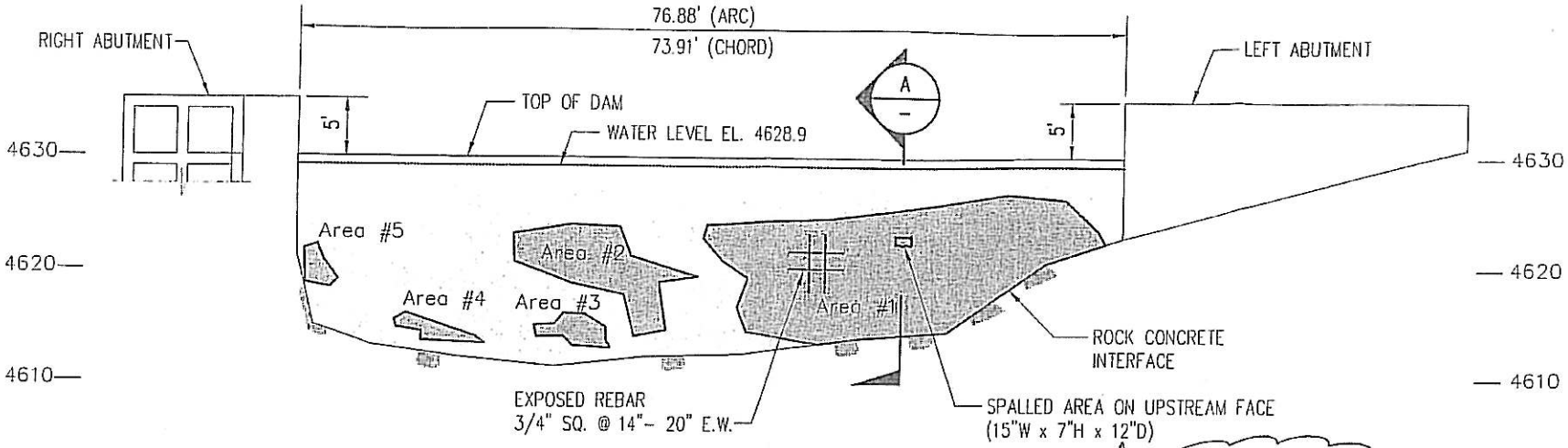
PHOTO 6 – CONCRETE DETERIORATION ON UPSTREAM FACE

PHOTO 7 – HOLE IN UPSTREAM FACE OF DAM

PHOTO 8 – SLUICE GATES

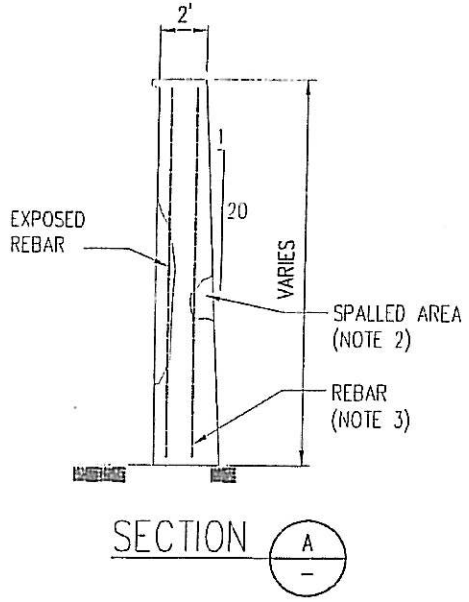
PHOTO 9 – SLUICE GATES

PHOTO 10 – SLUICE GATES



DOWNSTREAM FACE OF DAM (LOOKING UPSTREAM)

SCALE: 1"=10'



SECTION A

ERODED AREAS ON DOWNSTREAM FACE OF DAM			
LOCATION	AREA (SQ. FT.)	DEPTH OF EROSION (FEET)	9/18/07 DEPTH OF EROSION (FT)
AREA #1	315	0.7	1.2
AREA #2	71	0.7	NOT ACCESSIBLE
AREA #3	13	1.6	1.8
AREA #4	10	0.3	0.5
AREA #5	8	0.45	0.5
TOTAL ERODED AREA	417 SQ. FT.		

NOTES:

1. TOTAL AREA OF DOWNSTREAM FACE OF DAM = 1,178 SQ. FT.
2. SPALLED AREA ON UPSTREAM FACE OF DAM WAS DISCOVERED IN A DIVER'S INSPECTION ON OCTOBER 15, 1998
3. REBAR ON THE UPSTREAM FACE ARE ASSUMED TO BE SAME AS OBSERVED ON THE DOWN STREAM FACE. PRESENCE OF REBAR WAS NOT FIELD VERIFIED.

FIGURE 11

ALWAYS THINK SAFETY

REV NO	DESCRIPTION	DATE	APPROVED

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

LITTLE HYATT LAKE DAM
EXISTING CONDITIONS
FACE OF DAM

DESIGNED
REVIEWED
APPROVED

DRAWN OTAK, INC. | SCALE AS SHOWN
DATE 12-10-98 | SHEET OF
DRAWING NO. WI925015