Houston Engineering Inc.

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PELICAN RIVER DAM POWERHOUSE REPORT

Pelican Rapids, Minnesota

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Prepared for:
City of Pelican Rapids and Minnesota Department of Natural Resources – Dam Safety Division

Prepared by:
Houston Engineering, Inc.

HoustonEngineering Inc.

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am duly Licensed Engineer under the laws of the State of Minnesota.

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TABLE OF CONTENTS

1 INTRODUCTION 1
2 HISTORY 1
3 INSPECTION AND FINDINGS 3
4 RECOMMENDATIONS FOR REPAIR 7

1 INTRODUCTION

In the summer of 2016, the City of Pelican Rapids retained Houston Engineering, Inc. (HEI) to conduct an assessment of a rock masonry retaining wall that had failed at the Pelican Rapids Dam.

The assessment was published in a report titled “Pelican River Dam Rock Masonry Wall Failure Assessment Report” dated March 9, 2017. During the inspection of the rock wall on November 3, 2016, it was found that concrete components of the spillway were showing extreme deterioration. Before inspection of the structure could be completed, the structure needed to be dewatered and dry to allow access. The City started diverting flows through the powerhouse the week of August 7th. As flows were diverted and maintained through the powerhouse, several sinkholess formed around the powerhouse.

HEI was retained to investigate the powerhouse and determine the cause of the sinkholess and possible solutions to repair the damage.

This report covers the powerhouse inspection, its current condition, options for repair, and the associated costs.

2 HISTORY

In 1987 and 1988, the dam underwent major improvements requiring drawdown of the reservoir. The drawdown was achieved in part by installing two lines of 5-foot diameter pipe beneath the floor of the powerhouse.

The 1987 plans for the drawdown piping shows a portion of the powerhouse floor being removed then replaced. However, the record drawings show that the replacement of the floor was omitted. See Figure 2-1.

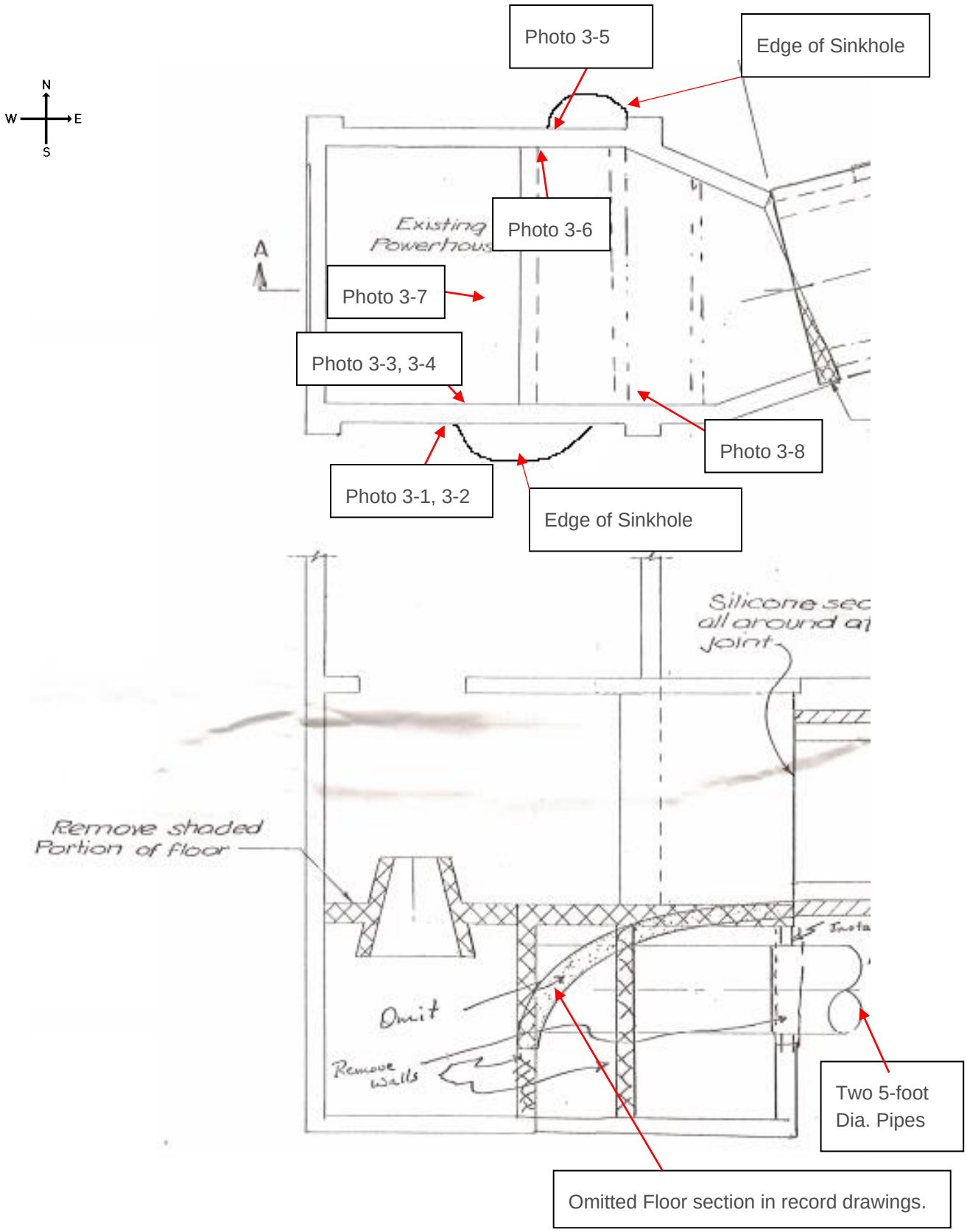

Figure 2-1 Detail from record drawings

3 INSPECTION AND FINDINGS

The inspection of the powerhouse was completed November 20th by Luke Beckermann, PE and Wes Keller after the structure was dewatered.

The inspection included a detailed visual and hands-on inspection of the existing concrete floor and walls on the interior of the powerhouse. The visual portion of the inspection consisted of determining why the sinkholess had formed from the interior of the structure. The hands-on inspection included sounding portions of the existing concrete with hammers in order to make sure the existing concrete was sound. Dull or hollow sounding concrete typically indicates degradation of the concrete. This generally indicates that there are either voids in the concrete or the concrete is not bonded to the reinforcement.

The inspection verified that part of the powerhouse floor had been removed and not replaced as indicated in the record drawings. When water was diverted through the powerhouse for the inspection of the spillway, the force of the water likely washed out the gravel beneath the powerhouse and undermined the foundation walls in the vicinity of the sinkholes. There were areas of the wall that had not been filled in with concrete between columns during the 1987-1988 project resulting in voids in the wall open to soil outside the building (see Photo 3-1 to 3-6). These specifically are the areas where the wall was undermined causing sinkholess on the exterior of the structure. Soundings also produced evidence that there was an area on the north wall below the pipe invert, where the existing wall exhibits deterioration. This was the only area of the powerhouse that was accessible where the concrete exhibits signs of deterioration. During the inspection, there was no evidence that water was seeping through the dam and causing piping or erosion of the gravel fill material.

Photo 3-1 Sinkhole on south wall of powerhouse

Photo 3-2 Sinkhole and undermining of south wall from exterior

Photo 3-3 Undermining of pipes and south wall

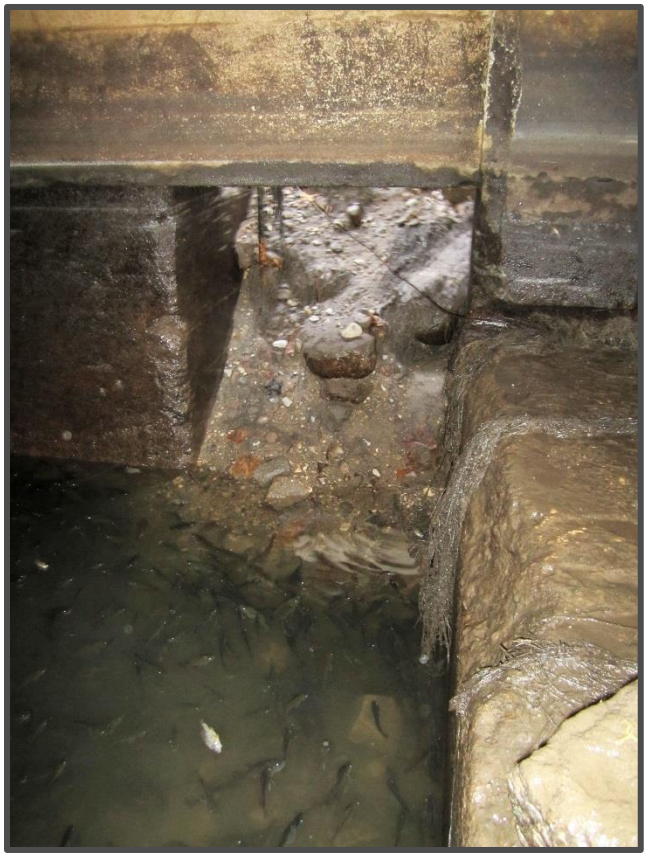

Photo 3-4 Undermining of south wall from interior

Photo 3-5 Sinkhole and undermining of north wall from exterior

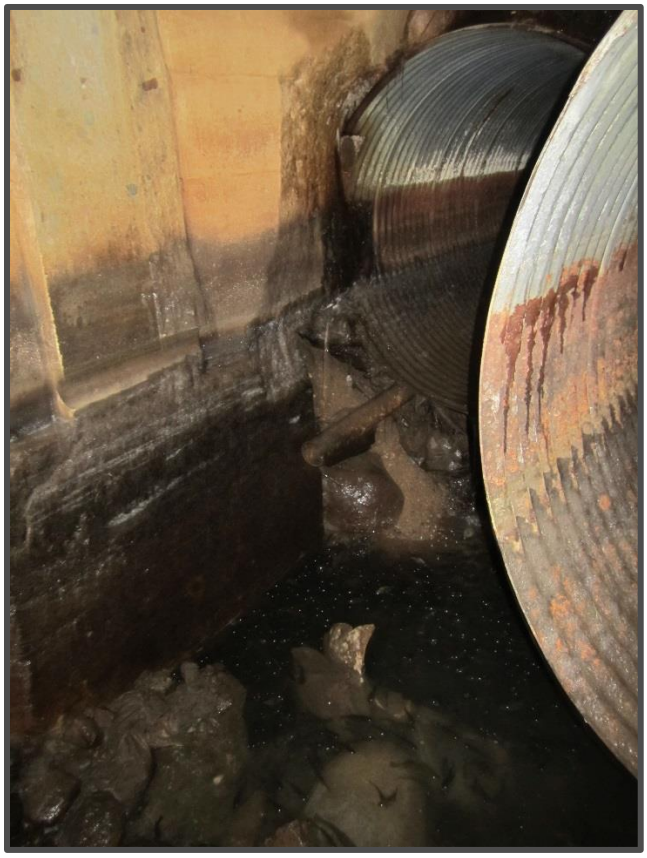

Photo 3-6 Undermining of north wall from interior

Photo 3-7 Washout of gravel floor and undermining of pipes

Photo 3-8 Additional wall pour requiring additional south sinkhole excavation

4 RECOMMENDATIONS FOR REPAIR

Recommendations for the repair of the powerhouse and sinkhole would consist of filling the voids with concrete. This would include a small amount of forming for the concrete walls and pouring a new concrete floor on the interior of the structure. The walls of the powerhouse could be formed from the interior using plywood and then poured from the exterior of the structure where the sinkhole would be filled with concrete slightly above the existing wall level. Concrete should be poured on the interior of the structure up to the pipe invert elevation. This would be an average of approximately 2' of concrete in depth, but could be up to 3' or greater in depth in isolated areas near the pipe invert. Pouring the floor would also cover the portion of wall with unsound concrete. In lieu of forming the walls of the powerhouse floor as well as the lower part of the sinkholes on the exterior of the building could be filled with concrete at the same time. If done during cold temperatures, the exterior concrete pours would need to be covered with blankets or enclosures to protect against freezing temperature. The interior of the powerhouse would need to be heated to above 40 degrees for 3 days for the interior concrete pours. A standard concrete mix with a 4" maximum slump and a 3,000 psi 28 day strength is recommended for the repairs. The remainder of the sinkhole above the pipe invert elevation could be filled with onsite material (clay or aggregate) and compacted.

In order to prepare the interior of the structure for concrete, the structure should be dewatered as much as possible. After the concrete is poured, the concrete would need to be protected from the water leakage through the stop logs either by covering the concrete with plastic or stopping the water from reaching the fresh concrete.

All of these repairs could be completed with approximately 30 yards of concrete. This repair, including dewatering, and filling the sinkholes, would cost approximately $10,000 to $15,000. Prices may vary depending on the time of year that the work is completed as well as availability of local contractors.