Concentric Associates International

Lake Geraldine Dam
Iqaluit, Nunavut
Dam Safety Inspection

February 16, 2005
REPORT

Produced For:
THE CITY OF IQALUIT, NUNAVUT

Produced By:
CONCENTRIC ASSOCIATES INTERNATIONAL

Concentric Project Reference Number:
04-1166

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1. EXECUTIVE SUMMARY

Concentric Associates International Inc., (Concentric) was retained by the City of Iqaluit, to undertake a Dam Safety Inspection (DSI) of the Lake Geraldine Dam. The scope of work for the assignment has been undertaken in accordance with Concentric's proposal 04-1166, dated November 19, 2004.

The site inspection and reporting were conducted on February 9, 10 and 11, 2005, by Allan Murray, P.Eng., of Concentric. Snow and ice cover did not allow adequate assessment of the structure. It is strongly recommended that the next DSI be conducted prior to October 2005.

OBSERVATIONS:

- No significant changes in condition were observed since the previous DSI

RECOMMENDATIONS:

1. Preparation of the required Operation & Safety Manual, Emergency Preparedness Plan, Logbook, and Permanent File, remains delinquent, despite initial identification for compliance in 2001, and repeated non-compliance in 2002, 2003, and 2004. Steps should be taken to address this issue in 2005, as continued non-compliance negates the purpose, and validity, of the entire process, that began in 2001 with the Dam Safety Review (DSR).

2. Undertake the next DSI prior to October 2005.

3. Reassess the performance of the 2003 crack injection program as part of the 2005 DSI.

4. Upgrade the embankment portion of the dam in 2005 as recommended in previous DSI's - engineering design is required prior to implementation.

5. The ground upwelling at the south end of the dam, noted in previous DSI reports, is still present, as evidenced by an ice outcropping at the location of leakage. This leakage should be reviewed in the summer of 2005 and if deemed necessary, repaired by excavation and injection in the fall of 2005.

6. The proposed dam raising project anticipated for summer 2005 will necessitate a new DSR. The DSR is recommended within the first year after construction; in the interim, the DSI recommended for later this year should note and summarize construction activities.

2. INTRODUCTION

Concentric Associates International Inc., (Concentric) was retained by the City of Iqaluit, to undertake a Dam Safety Inspection (DSI) of the Lake Geraldine Dam. The dam is located in Iqaluit, Nunavut.

This assignment and the scope of work described herein has been undertaken in accordance with Concentric's proposal 04-1166, dated November 19, 2004.

The site visit and reporting were conducted on February 9, 10 and 11, 2005.

Allan Murray, P.Eng., of Concentric, met with the following personnel at the City of Iqaluit:

- Brad Sokach, Director of Engineering, City of Iqaluit
- Geoff Baker, Project Manager, City of Iqaluit Department of Engineering

This report summarizes our terms of reference for the assignment, observations, conclusions and recommended action.

3. BACKGROUND

The Canadian Dam Safety Guidelines (DSG) requires that all structures exceeding prescribed height and volume minimums be subject to Dam Safety Reviews (DSR's) and Dam Safety Inspections (DSI's) at regular intervals.

A DSR is a comprehensive, formal review process that involves completion of checklist items in accordance with the Dam Safety Guidelines. The DSR forms a baseline of dam history, condition, repair requirements, and extensive documentation of monitoring, operating, safety and emergency procedures.

The Lake Geraldine Dam requires a DSR every seven (7) years. The DSR for the facility was conducted in 2001.

It is required in the DSG document that in the interval between DSR's, a Dam Safety Inspection be performed on an annual basis. The DSI is a much less comprehensive review, comprising a visual inspection only to identify any changes in condition, or any observed concerns.

A detailed historical perspective may be referenced in the DSR on file with the City of Iqaluit.

4. SCOPE OF SERVICES

Our directive has been to undertake a Dam Safety Inspection (DSI) in accordance with the DSG, for the Lake Geraldine Dam. The inspection consisted of an on-site visual assessment, notation of any significant changes in condition since the last available DSI, preparation of a written report in a format compatible with the DSR, and a photographic record.

The following is a summary of the scope of work for this assignment. The DSI report is the primary deliverable, and has been prepared in accordance with the DSG document.

- Review available record documentation, to be provided by the City;
- Review, in particular, reports and/or repairs/upgrades conducted since the 2001 DSR;
- Interview and/or solicit input from maintenance personnel and City Administration regarding operating performance, concerns, incidents, repairs, and any notable concerns;
- Conduct a visual on-site assessment of the sewage lagoon;
- Prepare a photographic record documenting general and representative conditions;
- Identify, characterize, and risk-assess any actual or potential concerns;
- Prepare a written report summarizing our observations, items of concern, and recommendations;
- Indicate any recommended repairs;
- Prioritize action items, and;
- Submit final documents in electronic format and hard copy.

Limitations

At the time of the inspections, visual acuity of the site was difficult due to snow and ice accumulation. Snow and ice cover did not allow adequate assessment of the structures. It is strongly recommended that the next DSI be conducted prior to October 2005.

5. SUMMARY OF PREVIOUS DSI'S

The following is a summary of observations and recommendations made from the previous DSI's:

Both the 2002 (Report 02-0823) and 2003 (Report 02-0823-0100) DSI's described below were prepared by Dillon Consulting Limited.

January 9, 2003 (2002) DSI

- The visible portions of the concrete structures are generally in good condition with localized scaling and spalling visible. No appreciable changes in the condition of the concrete were noted. The actively seeping shrinkage cracks that were observed in 2001 are, for the most part, unchanged.
- The rate of leakage through the control joint south of the spillway section has not changed significantly since the 2001 inspection.
- There was no evidence of distress or overstressing of any portion of the visible concrete structures.
- Minor corrosion of the 1985 spillway extension frame continues
- Significantly increased flow was noted at a joint location midway up the dam elevation, at the junction of the spillway section and the south gravity section. This area was reviewed on the upstream face by underwater video.
- The embankment portions of the dam do not appear to have changed appreciably in slope/stability since the 2001 inspection.

The following action was recommended:

- Undertake a Dam Safety Inspection (DSI) in 2004.
- Repair locations of significant and/or chronic leakage.
- Complete the remaining outstanding non-compliance requirements of Section Nos. 3 and 4 of the DSG, identified in the 2001 DSR document, as follows:
  - Permanent file
  - Operation, Maintenance and Surveillance Manual
  - Logbook
  - Emergency Preparedness Plan
- Upgrade the embankment portion of the dam - engineering design is required prior to implementation.

January 7, 2004 (2003) DSI

In May of 2003, the dam was visually inspected and was observed to be, in general, in a similar condition as found in August 2002. The only exception concerned the north berm section, where additional slumping of upstream fills was noted. The leakage that had been recommended for repair in the previous DSI was slated for construction in 2003.

In October 2003 the repair work (crack injection) was performed by Bellai Brothers Construction. A follow-up inspection in October 2003 confirmed that the prominent leaks and a number of the lesser leaks had been sealed.

The following action was recommended:

- Undertake a Dam Safety Inspection (DSI) in 2004.
- Assess repair performance in 2004.
- Complete the remaining outstanding non-compliance requirements of Section Nos. 3 and 4 of the DSG, identified in the 2001 DSR document, as follows:
  - Permanent file
  - Operation, Maintenance and Surveillance Manual
  - Logbook
  - Emergency Preparedness Plan
- Upgrade the embankment portion of the dam - engineering design is required prior to implementation.

6. COMMENTARY ON DAM SAFETY GUIDELINES

The Canadian Dam Association publication, Dam Safety Guidelines (DSG), governs the nature and frequency of inspection and review activities for structures which fall under its umbrella criteria.

The DSG applies to those structures that are at least 2.5 meters in height, and which have at least 30,000 cubic meters of storage capacity.

The DSG document is far reaching in terms of applicability and requirements for conformance. This is understandable as the type and complexity of structures that fall under the jurisdiction of the document varies considerably, from relatively small and simple embankments or dikes to massive and complex dams associated with hydroelectric generating facilities, irrigation, flood control, etc.

The DSG requires that all structures exceeding the height and volume minimums described above be classified according to their "consequence category", that is, the consequence of dam failure in terms of life safety, and socio-economic impact. The category assigned may range from very low to very high. The consequence category dictates the requirement and frequency of Dam Safety Reviews.

A Dam Safety Review (DSR) is a comprehensive, formal review process, conducted at regular intervals, that involves completion of checklist items in accordance with the Dam Safety Guidelines. The DSR forms a baseline of dam history, condition, repair requirements, and extensive documentation of monitoring, operating, safety and emergency procedures.

The frequency of DSR's varies depending on consequence category. For structures where significant life safety and/or socio-economic consequence exist, the DSR is usually conducted every five (5) to ten (10) years. Lake Geraldine Dam requires a DSR every seven (7) years. The initial DSR for the facility was conducted in 2001; therefore, the Lake Geraldine Dam is due for an updated DSR in 2008. If significant alterations to the structure take place before this date, an updated DSR would be required.

It is required in the DSG document that in the interval between DSR's, a Dam Safety Inspection (DSI) would be performed on an annual basis. The DSI is a much less comprehensive review, comprising a visual inspection to identify any changes in condition, or any observed concerns. The results of the DSI are incorporated into the DSR documentation. A DSI may trigger repairs, or changes in standard operating procedures.

7. OBSERVATIONS

The dam structure was accessed on foot. The review was hampered by considerable accumulation of snow and ice. Based on our limited visual assessment we have the following comments:

- The primary leakage addressed by polyurethane injection in 2003 appears to be performing adequately.
- Evidence of small volume seepage exists at some hairline crack locations.
- The ground upwelling at the south end of the dam, noted in previous DSI reports, is still present, as evidenced by an ice outcropping at the location of leakage. This leakage should be reviewed in the summer of 2005 and if deemed necessary, repaired by excavation and injection in the fall of 2005.

Overall, the condition of the structure has not changed significantly since the previous DSI.

We were advised by the Department of Engineering that a vertical expansion of the dam is being contemplated for the summer of 2005.

8. RECOMMENDATIONS

The following actions are recommended:

1. Preparation of the required Operation & Safety Manual, Emergency Preparedness Plan, Logbook, and Permanent File, remains delinquent, despite initial identification for compliance in 2001, and repeated non-compliance in 2002, 2003, and 2004. Steps should be taken to address this issue in 2005, as continued non-compliance negates the purpose, and validity, of the entire process, that began in 2001 with the Dam Safety Review (DSR).

2. Undertake the next DSI prior to October 2005.

3. Reassess the performance of the 2003 crack injection program as part of the 2005 DSI.

4. Upgrade the embankment portion of the dam in 2005 as recommended in previous DSI's - engineering design is required prior to implementation.

5. The ground upwelling at the south end of the dam, noted in previous DSI reports, is still present, as evidenced by an ice outcropping at the location of leakage. This leakage should be reviewed in the summer of 2005 and if deemed necessary, repaired by excavation and injection in the fall of 2005.

6. The proposed dam raising project anticipated for summer 2005 will necessitate a new DSR. The DSR is recommended within the first year after construction; in the interim, the DSI recommended for later this year should note and summarize construction activities.

9. GENERAL LIMITATIONS

The services performed and outlined herein were based in part, upon visual observations of the Site. Our opinion cannot be extended to portions of the Site that were unavailable for direct observation by objects or coverings at the time of our observations. It should that at the time of the inspections, visual acuity of the site was difficult due to snow and ice accumulation. As such, it is possible that certain conditions may exist that would not have been visible during our assessment. Should such an event occur, Concentric should be notified in order that we may determine if modifications to our conclusions are necessary.

The conclusions of this report are based, in part, on the information provided by others as described in the report.

This report has been prepared in accordance with generally accepted engineering practices. No other warranties, expressed or implied, are made as to the professional services provided under the terms of our contract and included in this report.

Concentric has prepared this report for the sole benefit of the City of Iqaluit. The material in it reflects Concentric's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Concentric accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

We would be pleased to discuss this report with you.

Should there be any questions, please contact the undersigned.

Yours truly,

Concentric Associates International Inc.,

Allan D. Murray, P.Eng.,
Project Manager

APPENDIX A
Photographs