Corporation of the City of
NEW WESTMINSTER

REPORT
Engineering Services

To:	Mayor Johnstone and Members of Council	**Date**:	October 30, 2023
From:	Lisa Leblanc Director of Engineering	**File**:	05.1035.10 (Doc# 2377319)
		Item #:	Report Number

Subject: **Canada Games Pool Tank Leak Causation Investigation Results**

RECOMMENDATION

THAT Council receive this report for information on the Canada Games Pool Tank Leak causation investigation results.

PURPOSE

To provide the results of the investigation into the causation of the Canada Games Pool Tank Leak.

SUMMARY

The Canada Games Pool (CGP) was scheduled to be permanently closed and decommissioned in August 2023 as part of a planned facility replacement and upgrade project, təməsewtxʷ Aquatic and Community Centre (TACC). The pool tank in CGP began leaking in October 2021. Repair strategies were considered, but the cost, risk, uncertainty and limited remaining useful life of the facility led staff to recommend not pursuing repair. Canada Games Pool was permanently closed in November 2021, several months earlier than planned.

An investigation into the causation of the tank leak was undertaken immediately and proceeded over the course of several months. Experts were retained to review the history, situation and circumstances surrounding the tank leak and to provide their opinion on the cause or causes of the tank leak.

The outcome of the investigation into the tank leak causation, as provided by the retained experts who oversaw the investigation, was that the CGP tank failure was caused by stress differential resulting from settlement of the sediments under the pool. Multiple factors may have contributed to this result, including exacerbation of pre-existing soil conditions. Fulsome analysis concluded that it would not be possible to accurately identify a single cause or a specific set of causes. As such, it has not been possible to attribute responsibility for the cause of the tank failure.

BACKGROUND

In April 2021, work began on the construction of the təməsewtxʷ Aquatic and Community Centre (TACC) which was set to replace the Canada Games Pool (CGP) and the Centennial Community Centre (CCC). CGP was intended to continue operating while TACC was constructed on the same site adjacent to CGP. Upon TACC's completion, CGP would be closed and decommissioned, with an anticipated closure date in August 2023

In September, 2021, CGP was closed for its annual scheduled maintenance shut down. On September 19th, following three days of heavy rain (an historic amount of precipitation which resulted in localized flooding and ground saturation), staff observed a high water level in the mechanical pit within the pool pump room, submerging the main pool circulation pump again. A temporary sump and pump installed as part of the construction of TACC was noted to have stopped functioning or did not automatically engage as it was designed to do; when the sump pump was manually turned on, the pool pump room pit drained within a matter of minutes.

On September 27th, the pool pump room flooded again when the temporary sump pump stopped functioning.

On October 7th, 2021, while CGP was still closed to the public, pool staff noticed a water level drop in the pool tank. Investigations into the pool level drop revealed that the tank had cracked and the pool was leaking. On October 9th, the north-west sump alarm activated (part of the existing site drainage system pre-construction), indicating that a high water level had been reached within that sump triggering the pump. Chemical testing of the water indicated that the sump was full of pool water. This coincided with another heavy rain event and the site became saturated.

As soon as the leak at CGP was confirmed, a consultant team was rapidly assembled to assess the situation and advise on next steps. Through the use of dye testing, sealing of all inlets and drains, and flow testing of pipes, the source of the leaks was identified with reasonable confidence as primarily flowing through cracks in the concrete, with some secondary loss occurring through the mechanical system.

Following temporary mitigation actions (filling the cracks with epoxy and sealing all drains and inlets), leakage occurring from the pool tank was reduced to minimal levels. However, it was suspected that some of the piping located beneath the pool tank was damaged.

Comprehensive analysis determined that repairing the pool was uneconomical, given the high cost of repair work, the length of time it would take to complete the repairs, and the remaining time available before CGP was scheduled to be decommissioned. Council made the difficult decision to permanently decommission CGP in November 2021. As a result of the early closure, the City *saved* $700K in operating expenses, equivalent to 0.76% tax dollars, which provided a "one-time" temporary relief on the 2022 General Fund Operating Expense Budget.

Staff and council committed to a thorough investigation into what may have caused the tank to crack and leak.

GEOTECHNICAL ANALYSIS

The City retained a geotechnical engineering firm (Geotechnical Engineer) to review the available data and present a professional opinion on probable cause of the tank failure. The Geotechnical Engineer was provided with previously commissioned geotechnical reports and assessments of the development of the site, along with other supporting material related to the existing CGP building, the new TACC construction, weather and activity logs before and after the tank failure.

Combining information from past analysis with new additional 3D modelling, the Geotechnical Engineer concluded that the variability in depths of fill and silt layers throughout the site was considerable. The soil around the existing CGP consisted of a thick layer of silt. The site explorations did not represent the static groundwater table clearly, and perched water encountered during drilling had been observed at a depth of 2 to 4 m below grade. The Geotechnical Engineer considered the groundwater level was in the range of 2 to 4 m below the grade and could vary with the seasonal weather trends, precipitation events, and by temporary dewatering during construction activities. They noted that the soil types under the CGP building footprint have significant potential for long term settlements and that buildings in the area utilize pile-supported foundations and suspended structural slabs. The foundation of CGP however was slab on grade with timber piles, which was likely the standard at the time of construction.

Past building condition reports were reviewed by the Geotechnical Engineer which recorded evidence of voids in the soils beneath the slab and a previous significant repair to the pool tank and mechanical system that occurred in the early 1990's. These reports indicated a tank failure had occurred in the same or similar location as the most recent failure. It is the Geotechnical Engineer's opinion that fine-grained silts in the soil beneath the pool slab had been experiencing ongoing settlement since its construction in 1972 for a combination of reasons.

The Geotechnical Engineer considered whether the TACC construction activities adjacent to CGP were contributing factors in the settlement of the soil under CGP. These construction activities included excavation work, compaction, temporary dewatering, drilling and installation of Controlled Modulus Columns ground improvement. The Geotechnical Engineer reviewed vibration monitoring reports recorded from the Metro

Vancouver (MV) sewer line that runs adjacent to the TACC site. The Geotechnical Engineer noted that while these activities could have cause sufficient disturbance to exacerbate pre-existing conditions, the MV sewer line experienced vibrations within acceptable levels and as the MV sewer line was closer to the construction than the CGP building, they expected that the same levels of vibration if not less was experienced at the CGP building.

The Geotechnical Engineer also considered how the failure of construction sump pumps controlling site drainage and the flooding of the CGP pool pump room in September and October 2021 may have contributed to the tank failure. They theorized that elevated ground water level could increase the buoyancy pressures under the concrete pool slab and cause uplift. In order to generate such uplift forces below the slab, the water level in the pool would need to have been lower than the elevated water levels around the pool. City of New Westminster staff confirmed that the pool level was maintained prior to the tank failure and therefore did not drop below any surrounding elevated groundwater levels, which rules out uplift as the cause of the differential displacement.

Over the course of the sump pump failures in September and October 2021, the foundation soils were subjected to a change in the groundwater hydrology from the flooding and subsequent drawdown as the pumps continued to cycle through the flooding and excess water removal. The Geotechnical Engineer noted that it is very difficult to quantify what impact this would have on the foundation soils. They theorized that given that the pool slab had already experienced settlement in the past due to poor foundation soils and documented voids, it is possible that the oversaturation of the foundation soils and potential vibration from the nearby construction activities could lead to further weakening of the slab foundation support. In the case of the sump pump failures, the impact the elevated water levels would have on the soils is very difficult to predict and the condition of the foundation soils are unknown. They conclude that it would be difficult to provide an engineering opinion that connects the sump pump failures as a direct cause to the cracking that was observed at the CGP.

The Geotechnical Engineer concluded the most likely cause of the CGP tank failure was differential settlement of the foundation soils below the pool tank, contributed to by factors such as the age and history of the building. They noted that multiple factors could have contributed or caused settlement to occur, such as weakening and consolidation of the foundation soils from changes in groundwater levels, poor soil quality at the CGP site, and/or nearby construction activities. As there was no direct correlation to the damage with any one particular event it was the Geotechnical Engineer's professional opinion that the cracking was a result of various factors. The fact that CGP had undergone similar cracking in the past and the effectiveness of the repairs are unknown, it was concluded that the pool was founded on poor soils that have been settling over time and that the foundation of CGP was not well suited to mitigating the effects of soil settlement and that previous cracking may have weakened the pool deck, causing it to be more susceptible to a rupture.

FINANCIAL IMPLICATIONS

The cost of expert and legal analysis has been tracked in the TACC project budget under soft costs; the budget allowance of $100,000 was exceeded. As of today, approximately $160,000 legal costs were spent on obtaining technical and legal advice, with an additional forecast of $15,000 to be invoiced. The overage will be covered by the TACC project contingency.

INTERDEPARTMENTAL LIAISON

This report has been reviewed by staff in Parks & Recreation, Finance and the Office of the CAO.

OPTIONS

Options for Council's consideration include:

THAT Council:

1. Receive this report for information;

Or:

2. Provide staff with alternate direction.

Options 1 is recommended.

CONCLUSION

The CGP tank failure was caused by stress differential resulting from settlement of the foundational soils under the pool. Due to a complex site history and the potential for multiple causes, expert analysis was unable to identify a clear cause or causes of the soil settlement and subsequent tank failure. Possible causes and contributing factors include the age of the facility and its foundation, construction vibrations from the adjacent TACC building, the earlier standard to which CGP was built, prior damage caused to the pool tank, and the weakening and consolidation of the foundation soils from seasonal changes in the groundwater. These seasonal changes include the extreme wet and dry weather encountered immediately prior to the failure.

Without a reasonable ability to identify the cause of the tank failure, it is not possible to assign fault.

APPROVALS

This report was prepared by:
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