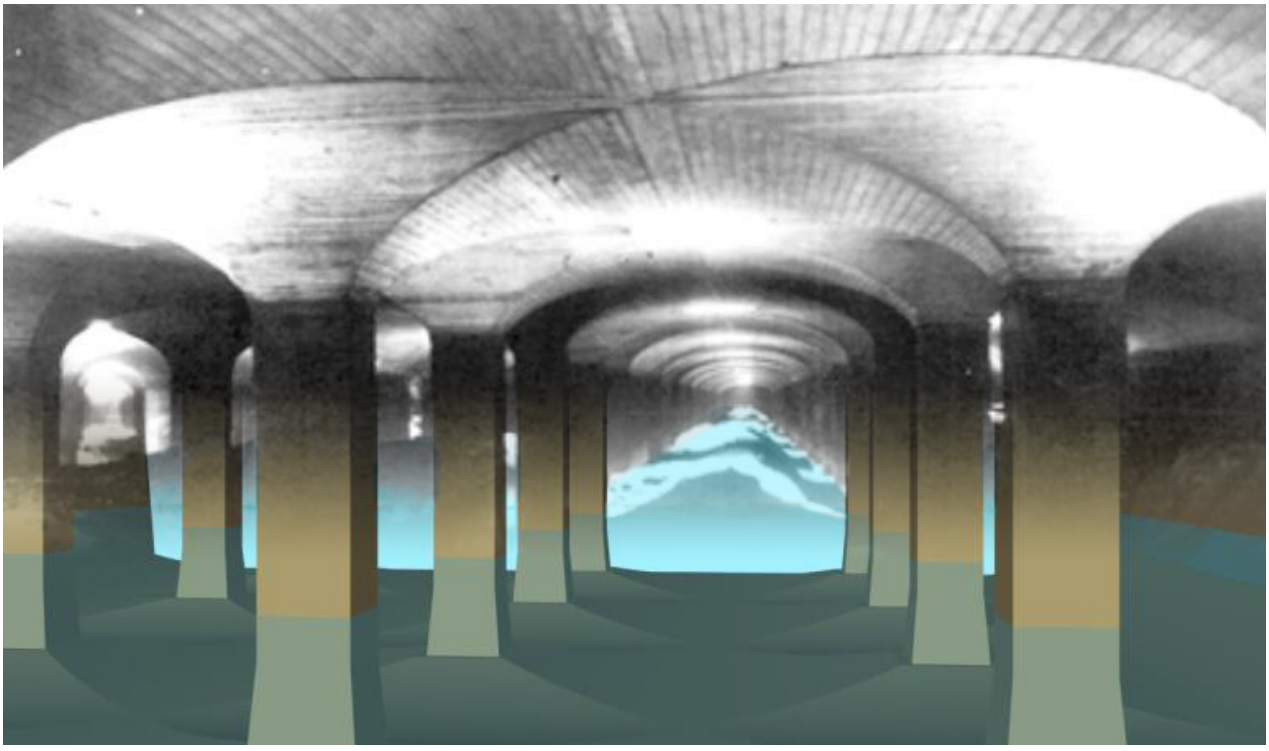
ROBERT SILMAN ASSOCIATES
STRUCTURAL ENGINEERS

EXISTING CONDITIONS ASSESSMENT & FEASIBILITY EVALUATION

McMillan Slow Sand Filtration Plant Site
Washington, DC



April 10, 2014

prepared for
Vision McMillan Partners
EYA | Jair Lynch Development Partners | Trammell Crow Company

prepared by
Robert Silman Associates
1053 31st Street NW
Washington, DC 20007

RSA PROJECT #W2771

EXECUTIVE SUMMARY

Robert Silman Associates (RSA) was retained to perform a structural investigation and feasibility analysis for potential restoration and/or adaptive reuse of the slow sand water filtration structurers at McMillan Reservoir. The structures were built in 1912 and consist of 20 underground filters, each consisting of multiple vaults of unreinforced concrete. The vaults are typically 14' x 14' and supported on a single column over a shallow inverted vault slab, cast on grade.

The structural investigation included a review of documents provided by the client and a structural condition assessment of representative areas of the installation. Particular attention was paid to areas documented in the most recent study, in 2000, in order to assess the general rate of deterioration. In general, the damage observed by RSA was similar to the conditions documents in 1944, 1967, and 2000; however, it was apparent that severe damage continues to propagate, and other areas at these filters are at risk of imminent collapse.

RSA performed a structural analysis and stability investigation of the slow sand filter assemblies to further explore the concerns outlined in prior investigations to develop an understanding of this historic structural system, identify the causes of the observed damage, and to determine its current and future ability to support both current and potential future loadings.

As part of this study, RSA provided a review of the “Structural/Geotechnical Engineering Evaluation of the McMillan Filter Site”, (CCJM 2000). The report includes a summary of a finite element analysis concluding that the structure has a capacity for 640 psf live load. However, it was also reported that "lean concrete ceilings are unsafe for public access because of their nearly zero elasticity". RSA commented that this report does not fully address the safety concerns for occupancy within the filters, does not address the concern about ongoing settlement or spread of the existing structure, and fails to note the important role of the perimeter wall in providing thrust resistance for the unreinforced concrete vaults within the filter system. Finally, the existing foundation capacity for new load was not evaluated.

To determine the ability of the slow sand filter structure to carry existing loads, and additional loads for future development, RSA used graphic analysis. Stability investigations were performed utilizing assumed failure mechanisms based on the results of the graphic analysis and field observations. Under the idealized case of uniform distributed loading, a theoretical live load capacity of approximately 2,800 psf can be calculated; however, the footing configuration of the slow sand filter structural assembly is vulnerable to failure at low levels of superimposed loading. Calculations of foundation capacity indicated that loads cannot exceed 150 psf under the most favorable soil conditions. When considering foundation settlement, the capacity reduces to 100 psf under settlement of ¾ inch and 1-1/2 inches respectively (vertical or horizon), and becomes unstable (causing collapse) at any displacement beyond that value.

The structural assembly of the slow sand filters, how their different parts come together, and how these parts are affected by different conditions such as unbalanced loads and settlement could create conditions leading to progressive collapse or global instabilities. The initial trigger for the collapse

appears to be the lateral and/or vertical movement of the end wall. The fact that no interior bays have collapsed is attributed to the amount of restraint offered by the surrounding bays and friction on the supporting columns. At entrance portals, the disruption of the structural symmetry affects the internal forces on either side adjacent to the entrance and, similar to the end bays, if enough hinges formed, this will lead to instability or collapse.

The slow sand filters are industrial structures, never intended to provide the level of safety and serviceability required for occupied use. There are unsafe conditions at the site that indicate settlement of a brittle heavy structure susceptible to sudden collapse. The concrete ceilings in the unreinforced concrete structure harbor loose material that can fall without warning. At the current pace, the entire end bay of filter No. 24 are expected to collapse within five years and it is expected that this would trigger collapse mechanisms at adjacent interior bays and other filters. Thus, RSA recommends that no activity take place on the property in its current condition.

Various potential options for the future of the site have been developed by the design team and are presented in the report: (1) do nothing; (2) repair/replace top surface for light use only; (3) repair/replace top surface for light use and interior tours; (4) repair/replace for programmed top surface and interior tours; (5) repair/replace for programmed top surface and interior programmed use; (6) repair/replace for overbuild and interior programmed use; and (7)new development at the site.

All adaptive re-use options and work at this site must be performed with great care and the knowledge of the limitations regarding loadings, sensitivity to settlement (vertical and lateral) from adjacent excavation or demolition. Where excavation or vibration generating construction activity is proposed, special measures, (including underpinning, rigid temporary retention systems, or temporary retrofit), will be necessary to protect the filters from further damage or collapse. Calculations have indicated that the existing foundations have likely failed but are not accessible for visual inspections. This consideration will become the limiting factor for even the minimal re-use. The foundations will need to be exposed and soils tested to determine the allowable bearing capacity of the sub-grade, and to establish repairs that need to be made, appropriate for the proposed restoration or re-use.