Attachment 1

City of Alexandria Recreation, Parks, and Cultural Activities Final Facility Assessment Report

November 2015

Prepared for:
City of Alexandria
Recreation, Parks and Cultural Activities
Park Planning, Design & Capital Development
1108 Jefferson Street, The Lee Center
Alexandria, VA 22314

Prepared by:
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November 30, 2015

Mr. Ron Kagawa
City of Alexandria
Recreation, Parks and Cultural Activities
Park Planning, Design & Capital Development
1108 Jefferson Street, The Lee Center
Alexandria, VA 22314

Dear Mr. Kagawa:

Attached is our revised final assessment of the Warwick Pool facility with all figures and appendices included for your review. This version incorporates changes arising from our telephone conversation of November 11th.

The focus of this evaluation was to assess the existing pool house and pool basins to determine the level of resources required to bring this facility up to current codes including the Americans with Disabilities Act (*ADA*). This report completes our Scope of Services as presented in our proposal of May 6, 2015. As requested we have included an analysis of per floor costs for renovating the pool house and the inclusion of 25% contingency costs and added a one-story pool house alternative.

Cardno looks forward to continuing its work with the City on this project. If you have any questions or require additional information, please contact us at 804-798-6525 or at eric.powers@cardno.com.

If you have any further questions please do not hesitate to contact us

Sincerely,

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Enclosure:

File: City of Alexandria Report 11 30 15 Final Rpt.

Project COA320

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Appendix

1 Executive Summary

The **City of Alexandria Department of Recreation, Parks and Cultural Activities (*RPCA*)** has tasked **Cardno, Inc. (*Cardno*)** with evaluating the feasibility of either renovating or replacing its Warwick Pool facility. The facility, which includes a full size pool basin, wading pool, pool house and grounds, was constructed in 1958 and has been operated by RPCA since 1978. Of key concern is whether the facility can be cost effectively renovated or if the level of complexity and uncertainty involved exceeds those estimated for constructing a new facility on the same site.

Cardno's study is a follow-up to several earlier condition assessments conducted on behalf of the City's **Department of General Services (DGS)** by **Camp Dresser and McKee (*CDM*)** in 2001 and another conducted by DGS along with input from consultants **Kimley-Horn (*KH*)** in May of 2014. The earlier studies assessed the condition of the pool house (DGS) and pool basin (CDM and KH) and identified specific issues and deficiencies that would need to be addressed before the facility could be brought back into service. Although the CDM report provided the most comprehensive assessment of condition for the pool basin, its 2001 submission date limits its relevance since no information on subsequent repairs is available. In general, the DGS and KH reports identified a number of significant maintenance issues affecting future pool operations and divided them into three tiers of importance including: Tier 1 – urgent items affecting facility safety and performance; Tier II – items of probable risks over the next four years; and Tier III – items of potential risk over the next four years of operations. The DGS portion of the report estimated the cumulative costs to correct all three tiers for the pool house between $178,850 and $299,200. Based on their observations, KH conducted a similar analysis for the facility and concluded that: "The majority of site features are in need of replacement and show signs of wear and degradation." They also indicated that although the pool basin is in usable order, cracks in the pool walls and deck point "to possible larger problems in terms of settling and stability." KH estimated that correcting issues associated with all three tiers (pool house and pool basins) would cost between $$1,272,320 and $1,688,380.

While Cardno's study considered the findings of the earlier reports, the focus of its follow-up assessment was to integrate these findings with a broader-based study to evaluate key components of the facility with the goal of deciding whether renovation or replacement would provide the best option for the City and facility users. Cardno's study included architectural, structural and geotechnical assessments including an assessment of Americans with Disabilities Act (*ADA*) compliance, general structural condition of the pool and pool house, site substrate testing for evaluating their suitability for future construction and a site survey for buried utilities and site planning. The architectural and structural assessments were based on visual observations made during several site visits made during the spring and summer of 2015 while the geotechnical study included drilling and sampling of site substrates that same year. The site survey was undertaken by Cardno's registered land surveyor with assistance from our subsurface utility engineering department.

Although the structural assessment did not identify any conditions that would preclude renovating the pool house and pool basins, several issues were identified that would require attention. Included were structural and drainage issues associated with the south wall which has undergone at least one earlier repair to stabilize the structure and keep water from seeping into the building. Permanently correcting the water-related problem would require retrofitting a foundation drain system to eliminate the build-up of groundwater behind the wall. Other structural issues noted in the pool house included several settling cracks in exterior walls and cracked/settled floor slabs.

Cardno's assessment of the pool basin is based in part on the prior surveys conducted by KH and CDM. However, Cardno's direct observations were consistent with those made in the earlier assessments including the observation of cracks in the upper four feet of the pool walls and significant cracks and settling in the pool deck. The earlier assessments had also noted that in some areas, multiple layers of resurfacing within the pool walls was delaminating, diminishing the effectiveness of repairs. However, the pool bottom appears to remain structurally sound and could provide a basis for retrofit using an internal liner system such as a Myrtha Renovate type system. However other deficiencies were noted with the pool system including undersized recirculation piping that limits water filtration and turnover to current standards and pumping/filtration equipment that is near the end of its service life. Moreover, the City reports that when full, the pool loses in excess of 6,000 gallons of water per day, suggesting that either the piping or the pool walls are leaking. Although it remains possible that the pool could be re-lined with a Myrtha-type system, the need to replace significant segments of piping beneath the pool bottom by cutting into the bottom may compromise the long-term integrity of the refit.

The architectural assessment focused on identifying both condition and design aspects of the facility that might limit the cost effective renovation of the facility. In particular, the study identified non-compliance issues with the interior floor plan with respect to the ADA. While it would be possible to reconfigure the pool house interior and facility grounds to comply with requirements for slopes, clearances and access to all spaces within the facility, some compromises with other functional aspects of the facility would be required. As with the structural review, the architectural assessment observed that all of the pool house's floor and wall finishes, mechanical and electrical systems were beyond their service life and would need refit or replacement.

The cost analysis considered the merits of renovation versus replacement on the basis of rough estimates for replacing each facility component. No attempt was made to assess the fitness of purpose of the existing facility, but the comparisons assumed both in-kind and reduced replacements compared to in-kind refits of existing systems using same basic layout. Depending on the City's mission for the facility, it is conceivable that modifying the facility requirements such as the number of users or the type of use could influence decisions regarding the final design and therefore the relative cost effectiveness of renovation over replacement. Among these considerations is whether to design a one or two-level facility within the existing footprint. For Cardno's final analysis three alternatives are considered: Alternative 1 – In-Kind Renovation, Alternative 2 – In-Kind Two-Story Replacement Pool House and Alternative 3 – Replacement One-Story Pool House.

The analysis concluded that the City could renovate the existing pool house and basins (Alternative 1) at a cost of between $2.4 and $2.8 million but in-kind replacement (Alternative 2) could be undertaken for a somewhat lower cost of $2.1 to $2.7 million. Significant savings could be realized by replacing the two-story pool house with a one-story pool unit constructed on a common grade with the pool deck and operated on a seasonal basis (Alternative 3). Although this approach reduces the functionality of the facility to support only the aquatic mission, it reduces the capital costs by $0.4 to $0.6 million by reducing basic construction costs and eliminating the need for an elevator. It is reasonable to expect that the operating and maintenance costs for the smaller, simpler and seasonally-operated facility would also be considerably reduced.

Based on the evaluation, Cardno recommends completely replacing the both the pool house and pool basins with new construction. Taking this approach not only reduces overall costs but it also avoids the inherent risks associated with attempting to retrofit aging structures. More importantly undertaking a new design and construction provides the City with the opportunity to re-assess the facility's mission so that the design can be optimized for its purpose. New construction also provides the opportunity and flexibility to optimize the design to utilize modern materials and components to realize better operating and maintenance efficiencies and therefore improved life-cycle costs.

2 Project Overview

2.1 Purpose

Cardno, Inc. (*Cardno*) has evaluated the feasibility of renovating or replacing the City of Alexandria's (*City*) Warwick Pool facility. The purpose of the study is to aid the City of Alexandria's **Department of Recreation, Parks and Cultural Activities (*RPCA*)** in determining how best to rehabilitate the currently-idled recreational facility. The evaluation was based on site inspections and assessments conducted by a registered architect supported by professional structural and geotechnical engineers. Supporting surveys and inspections for utilities were also conducted to identify key elements that would weigh into the costs and feasibility of either the remodel or rebuild options. Key factors included assessing the overall condition of the pool and pool house in the context of how the design and physical constraints of the existing structures might favor or preclude renovations needed to bring the facility up to current codes including the Americans with Disabilities Act (*ADA*). Cost estimates for correcting deficiencies identified in the study are weighed against potential benefits to determine which option yields the most favorable approach for restoring the facility to community use.

2.2 Scope

Cardno's evaluation is broken into the following tasks:

> **Task 1 – Summary of Initial Findings**

Prior to undertaking the complete assessment, the City requested that Cardno conduct a preliminary assessment to identify any obvious "fatal flaws" in the structural or architectural aspects of the facility that might preclude a remodel option or perhaps even replacement with a new structure on the same site. This broad-brush assessment mainly focused on the fundamental configuration and condition of the pool house with the emphasis on whether it is possible to retrofit the existing structure to comply with the ADA and/or address obvious structural deficiencies.

In its preliminary assessment report submitted to the City on June 23, 2015, Cardno reported no major flaws that would prevent renovating the facility. Consequently, the City directed Cardno to proceed with the full scope excepting the hazardous materials survey.

> **Task 2 – Architectural/Electrical/Mechanical Assessment**

The purpose of the architectural assessment was to evaluate the suitability of the existing structures to serve their intended function in compliance with all applicable codes, laws and regulations and to determine whether it is possible to cost-effectively retrofit or replace the structure in order to comply with the ADA and other relevant codes. Other relevant limitations to be considered included building and infrastructure condition, space utilization and supporting system limitations including electrical and mechanical facilities.

> **Task 3 – Structural Assessment**

The structural assessment focused on identifying evidence of structural distress and areas of deterioration that might preclude any cost effective renovation of the existing structure. Particular focus was given to load bearing, exterior masonry walls. The inspection also addressed readily visible and accessible elements of the pool and deck structure. The results of the structural investigation was integrated with the architectural and geotechnical studies with regards to the structural effects of ADA requirements. Other key issues included the condition and suitability of the existing electrical and mechanical systems to support future use.

> **Task 4 – Geotechnical Assessment**

The geotechnical assessment characterized substrates beneath the site to evaluate their suitability for supporting existing or future structures. The study included direct sampling and testing of site soils in the vicinity of the existing pool and pool deck, pool house structure, and entrance road. Subsurface conditions and soil types have significant impacts upon project construction/renovation costs, particularly with respect to design of helical anchors for the pool liner and importing/exporting of structural fill.

> **Task 5 – Subsurface Utility Location and Land Survey**

A basic topographic survey of the subject parcel was prepared to support the other disciplines. In addition to providing a detailed site layout of surface structures and site boundaries, underground utilities were also mapped to aid in the positioning of boreholes advanced during the geotechnical assessment.

> **Task 6 – Asbestos, Lead-based Paint and Hazardous Materials Survey**

A survey of hazardous materials was to be undertaken to identify building materials, equipment and stored materials containing hazardous substances requiring special handling during renovating or demolition. The study was to include an inspection of entire pool house to identify asbestos containing materials (*ACMs*), lead based paint and toxic materials requiring future management. This work was delayed pending the submittal of a draft final report to the City. A general assessment of potential on-site hazardous materials is provided based on the age and condition of the structures.

> **Task 7 – Final Report**

The final report combines the findings of all included surveys and presents Cardno's overall judgments regarding significant limitations impacting the renovating or replacement of existing facilities.

2.3 Methodology

The evaluation integrates direct field observations and testing with previous studies and reports provided by the City. For some aspects, Cardno's site inspections included direct sampling and testing of soil and substrate materials to assess their suitability for supporting future repairs or site redevelopment. Cardno's site visits and testing were conducted during the following events:

> Review of existing reports and data,

> Preliminary Site Visit – April 8, 2015 by Mr. Eric Powers, C.P.G., Mr. Wayne Tucker, PE,

> Preliminary Architectural Inspection - June 12, 2015 by Michael Osteen, AIA, LEED AP.

> Preliminary Structural Engineering Observation - April 8, 2015 by Mr. Lee Ressler, PE, LEED AP BD+C,

> Site Survey and Utility Survey – July 5, 2015 by Mr. Tim Payne, RLS, Mr. Jeff Bailey,

> Geotechnical Site Investigation – July 7, 2015 by Mr. Wayne Tucker, PE,

> Follow-up Architectural Inspection – July 13, 2015 by William Luthie, PE, LEED AP, CEM Senior Engineer; J Michael Osteen, AIA, LEED AP, Senior Architect,

> Follow-up Structural Engineer Observation – August 26, 2015 by Mr. Craig Myers P.E., LEED AP BD+C, and

> Follow-up cost estimating provided from local pool construction and maintenance providers.

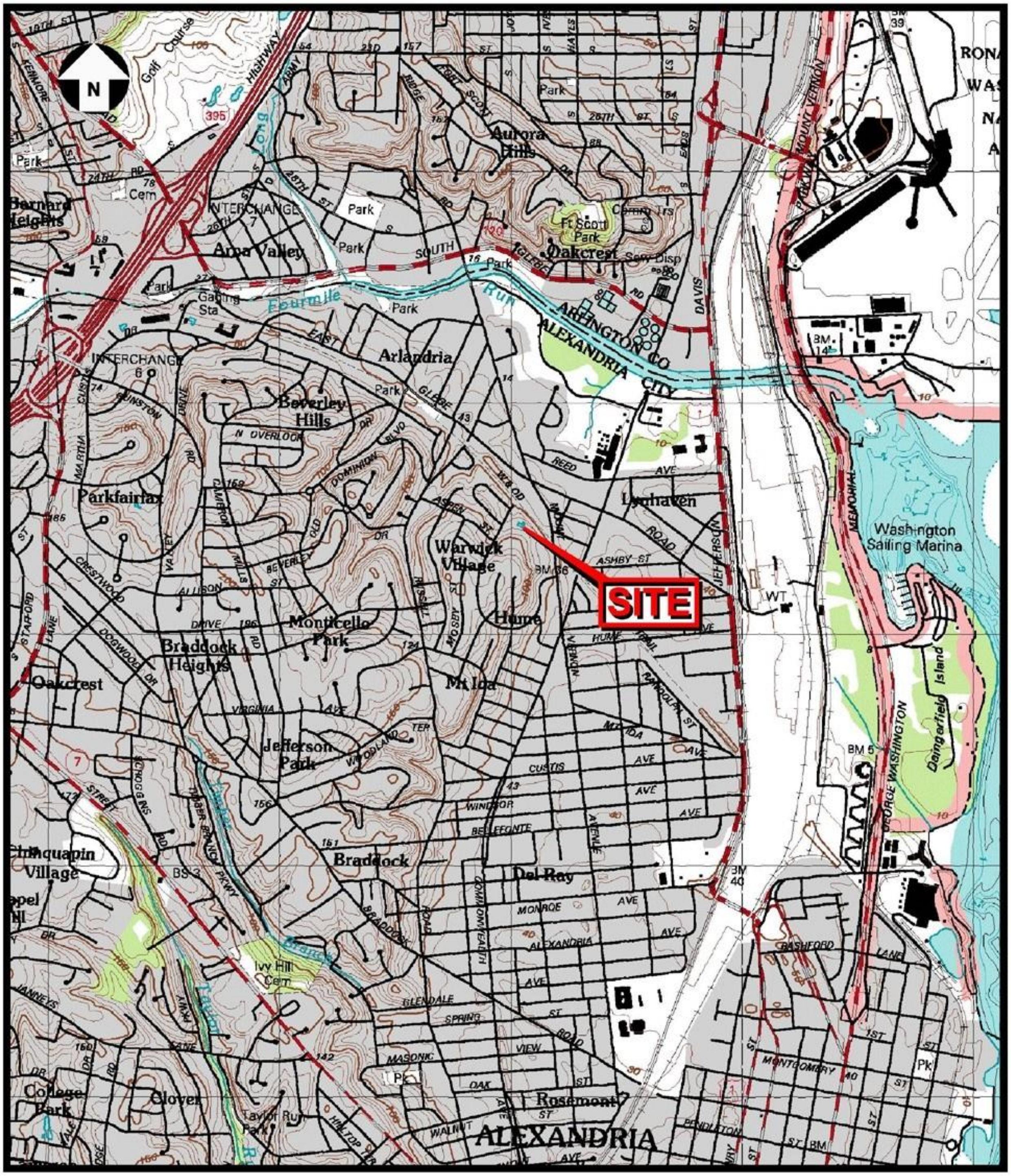
3 Site Description

3.1 Facility Location and Setting

Warwick Pool is located in the City of Alexandria at 3301 Landover Street adjacent to the Landover Playground **(***see Vicinity Map***)**. The facility is situated east of the intersection of Burgess Avenue and Landover Street. The property is bounded to the north by Landover Park, to the northeast by adjacent residential town homes, to the west by Landover Street, to the south by an existing high-rise residential building, and to the southeast by wooded areas. The site occupies the north-facing slope of a riverine terrace. The topography of the site generally slopes towards the north-northeast with the highest area of the site parallel to the asphalt drive adjacent to the pool house (approximate elevation +84 feet, mean sea level – [msl]). The lower portion of the site in the vicinity of the pool area, is generally flat with elevations on the order of about +73 to +74.5 feet, msl.

3.2 Facility Description, Plan and Layout

The facility occupies a 0.75-acre parcel located on a north facing hillside overlooking the Mount Vernon Avenue corridor **(***see Site Plan – Figure 1***)**. Access to the pool house and pool is provided by a one-lane paved driveway leading to Landover Street, which borders the western edge of the property. The northern edge of the property borders a small City-operated playground (Landover Park) and an adjoining residential townhouse complex which fronts to Sanborn Place to the north. The eastern edge of the property is bordered by a water utility-owned parcel used for water storage and transfer. The southern edge of the property adjoining the paved driveway abuts a parking lot for an adjacent high-rise condominium building (The Aspen). The surrounding neighborhood is comprised of mixed single and multi-family residential dwellings.



USGS7.5'ALEXANDRIA, VA QUADRANGLE 11M
CONTOUR INTERVAL=10'

COA320
0812412015

Warwick Pool Facility

3301 Landover Street
Alexandria, Virginia

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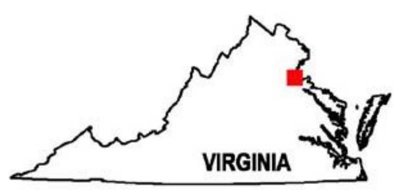
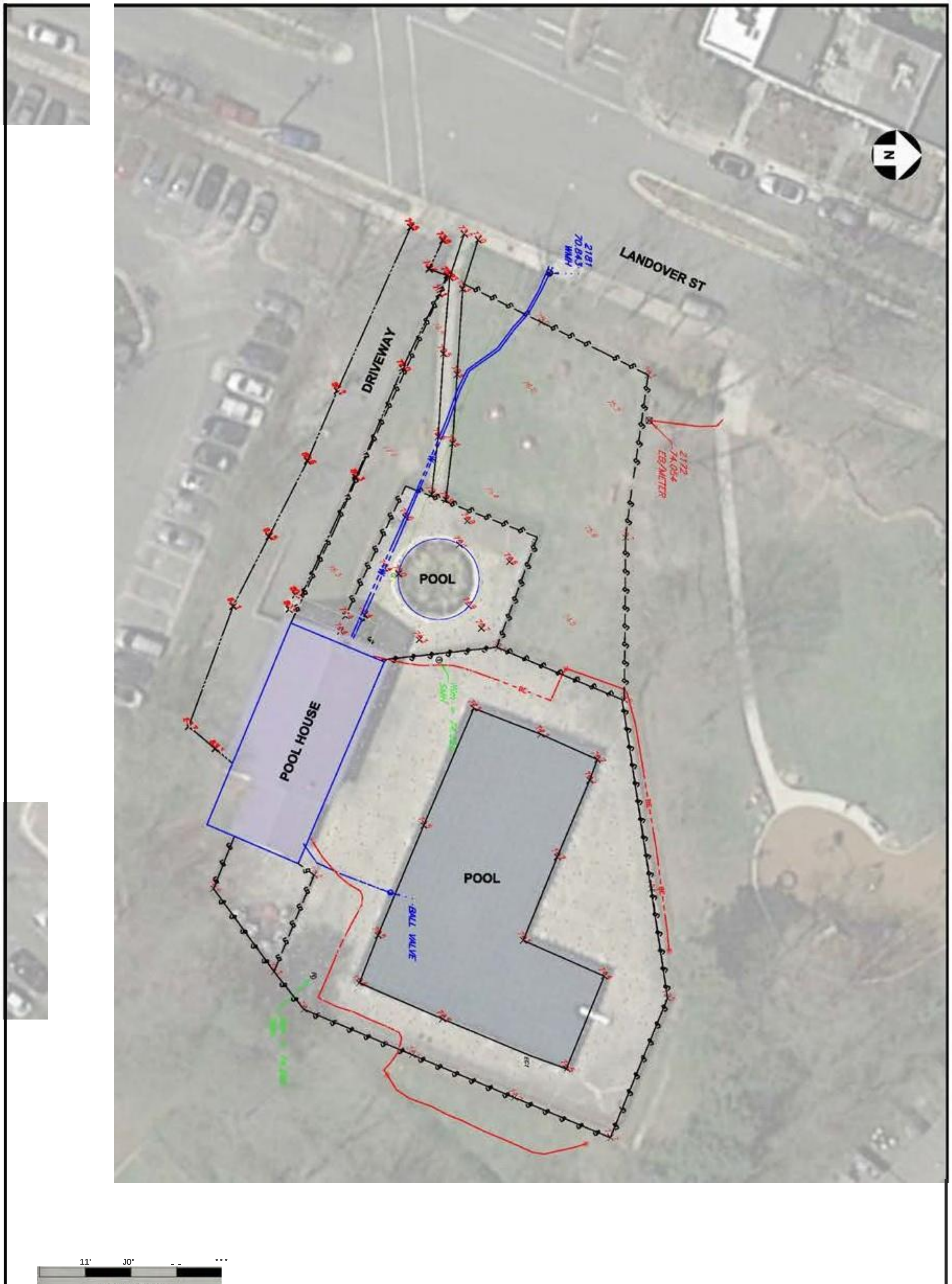
SCALE 1:24,000

Vicinity Map

Cardno
Shaping the Future
ASHLAND, VA.





Warwick PoolFacility
3301 Landover Street
Alexandria, Virginia

Site **Map**

FILENO.: COA-Warwick Pool.dwg
PROJECT: COA320
OFFICE LOC.: VA.I.ISA
SCALE: AS SHOWN

Cardno
Shaping the Future

The site is occupied by an existing two-story pool house and adjoining below-grade swimming pool and wading pool **(***see Photo 1, Appendix A***)**. The existing pool building structure, which is present at the south side of the property, appears to be constructed of concrete masonry unit (*CMU*) exterior walls and interior timber framing. The pool house building is presumably supported by spread footing foundations. The site is further improved by a 25-yard concrete-lined pool with diving well and a separate wading pool. The pool deck area is surfaced in wire-reinforced concrete **(***see Photo 2, Appendix A***)**.

The 3,350 square-foot, two-story pool house occupies the southern edge of the property and is recessed into the north-facing slope overlooking the pool and surrounding concrete deck **(***see Photo 1, Appendix A***)**. The pool and deck are enclosed by a six-foot high chain-link fence with its principle ground level access entering from Landover Street. The remainder of the property outside the pool fence is occupied by a grassed terrace equipped with several picnic tables and outdoor seating.

3.3 Regional and Site Geology

The subject site is situated in the coastal plain physiographic province. The region is underlain by a seaward-thickening wedge of unconsolidated marine sediments deposited during successive periods of fluctuating sea levels and migrating shorelines. Coastal plain strata thicken from a feather edge near the fall line (the western edge of the Coastal Plain) towards the Atlantic continental shelf, where they are thousands of feet thick.

The site is underlain by the Cretaceous Potomac Formation, which consists of clay, sand and gravel deposited during the Cretaceous Period. The clayey soils of the Potomac Formation are often moderately- to highly-plastic in nature, and are colloquially referred to in the Washington D.C. metropolitan area as “Marine Clay.”

The soils in the area are typical of those laid down in a shallow sloping sea bottom: sands, silts, and clays with irregular deposits of shells. Some of the existing formations contain predominantly plastic clays interbedded with strata of sands and poorly consolidated limestone. Others contain predominantly sands and chalky or porous limestone with local lenticular deposits of highly plastic clays

3.4 Existing Site Conditions

A reconnaissance of the subject site was made by Cardno and City personnel on April 8, 2015 to observe and document existing site conditions. Observations and measurements made during this and later visits provided the foundation for this study. The facility was idle at the time of our preliminary and follow-up site visits.

The asphalt-surfaced driveway was observed to be in poor condition with numerous signs of excessive rutting, potholing and pavement breakage. The reinforced concrete pool deck was cracked and settling in some areas but otherwise appeared to be in generally acceptable condition. The pool house was observed to be in generally fair condition, with signs of minor wall settlement (step cracking) present at the divider wall in the basement. Some evidence of moisture intrusion was evident in the below-grade interior walls.

Observations made during the April 2015 and later visits confirmed conditions observed by Kimley Horn in their 2014 assessment including the overall poor condition of the pool and pool house including specific defects identified as cracks in building walls, floors and pavements and the pool walls and deck. The following sections detail specific architectural, structural and geotechnical issues identified in the study.

3.5 Facility Use and History

The Warwick Pool facility is primarily used as an aquatic recreational facility and community meeting venue. The facility attracts use from the surrounding residential neighborhood and is a constituent of the City’s parks and recreational facility network designed to provide all of the City’s residents nearby access to recreational and cultural opportunities. The pool house and pool components have been in use since approximately the late1950’s with multiple service repairs and upgrades occurring over the years. The City has operated the facility since 1978 but closed it in 2014 due to deficiencies affecting its safe and efficient operation.

3.6 Site Ownership

City of Alexandria Geographic Information System (*GIS*) property records (Online Parcel Viewer, 2015) lists the subject parcel (# 015.03-07-01.L2) as owned by the Protestant Episcopal Theological Seminary in Virginia. The owner mailing address is listed as 3737 Seminary Road, Alexandria, VA 22304-5202. The legal description is listed as "Lot leased to the City of Alexandria Div. Land of Helen C. Calvert". Prior reports provided by the City indicate the lease was transferred to the City by the Warwick Investors in 1978. The records indicate the facility was constructed in 1958.

The assessed value of the property as of January 2015 was $423,538. The parcel (#015.03-07-01.L1) occupied by the adjoining playground to the north is also under the same ownership as is the adjacent 6-acre property to the south (#015.03-07-02) now occupied by a high rise condominium building. Based on the land records, expanding the facility footprint would involve purchasing land from one of the adjacent entities.

3.7 Prior Assessments

In May 2014, the City's Department of General Services (*DGS*) conducted a general assessment of the Warwick Pool facility on behalf of the RPCA. While not an engineering assessment, the study documented key issues and deficiencies requiring attention before the facility could be put back into service. As part of its study, DGS looked at the following:

1. Exterior Building Systems,
2. Mechanical and Plumbing Systems,
3. Electrical and Communications,
4. Americans with Disabilities Act (ADA), and
5. Interior Building Systems

The results of the assessment were reported to the RPCA in a memorandum dated May 21, 2014. DGS reported that although their assessment was not based on an engineering study, they had nevertheless identified a number of defects, limitations or hazards and assigned each using a three-tier ranking – repeated here:

Tier One - Items in urgent need of repair due to their potential as a hazard or unmet performance or potentially not code compliant during the four-year operational period of 2016-2020.

Tier Two - Items that represent a probably risk factor during the four year operational period of 2016-2020 and are recommended for immediate remedy.

Tier Three - Individual items that represent a potential risk factor during the four-year operational period of 2016-2020 but do not currently possess the urgency of Tier One or Tier Two.

The table below summarizes the DGS findings and estimates costs for correcting them:

Tier	Number of Issues Identified	Approximate Cost
Tier One	15	$28, 650 - $50,200
Tier Two	9	$129,700 - $215,000
Tier Three	4	$20,500 - $34,000
Total	**28**	**$178,850 - $299,200**

The DGS assessment identified several urgent life, safety and maintenance issues requiring attention in order for the facility to be returned to service. These issues were deemed the most important, requiring immediate attention before facility operations could resume.

Attached to The DGS memorandum was a document prepared by Kimley Horn (May 2014), who conducted an in-depth engineering evaluation of the facility.

The results of Kimley Horn's assessment are summarized below.

Tier One – The need for multiple access upgrades was noted including renovations to the concrete entrance path, access to the upper deck of the pool house and replacement of the concrete pool deck. KH recommended immediate replacement of the concrete walk from Landover Street to the wading pool citing severe tripping hazards and steep slopes. Other conditions noted included clogged pool drains, poor condition of the pool deck and associated tripping hazards. KH recommended inspection and repairs to the pool deck, sidewalk, cleaning of the pool drainage system, re-grading the concrete sidewalk and the removal/replacement of the concrete stair.

Tier Two – KH noted the majority of the facility's components are beyond their accepted life expectancy and recommended the following major renovations:

> Replace concrete pool decking,

> Replace pool drainage system,

> Repair asphalt drive and entrance areas,

> Repair concrete stabilization and timber retaining walls,

> Tree removal along pool fence,

> Replace site lighting, and

> Site grading, stabilization and drainage improvements.

Tier Three – KH relayed the City's pool service contractor Pool Service Company (*PSC*) report on the condition of the pool itself. PSC reported that although the main pool was re-plastered in 2009, light cracking and crazing were noted in the top 3-4 feet of the wall. An earlier report of inspection by **Camp Dresser and McKee (*CDM*)** in 2001 noted significant structural deterioration due to water ingress through the multiple wall layers. They nevertheless advised that replacing the pool liner would not be recommended. CDM had noted other defects in the main pool and wading pool including cracks in the tiles below the coping and consistent cracking around the wall. KH noted no ADA access was available from the street and lower level to the upper level of the facility. As part of the Tier III recommendations they included the following:

> Pool Replacement - Demolish and replace pool walls, coping, liner and associated equipment,

> Wading/Children's Pool Replacement – Demolish and replace existing pool and deck,

> Provide new concrete ramp – in addition to upgraded steps, provide ramp for universal access to upper and lower levels of pool house as well as a connection to the street.

KH provided a detailed opinion of probable cost for the above items. The Tier One, Two and Three Totals are summarized below:

Tier	Low Cost	High Cost
One – Urgent Hazard	$65,320	$105,080
Two – Immediate Remedy	$518,300	$695,800
Three – Potential Risk	$688,700	$887,500
Totals for Combined Tiers	**$1,272,320**	**$1,688,380**

4 Structural Overview

4.1 Structural Overview

Cardno's structural engineering survey focused on identifying issues and deficiencies associated with the pool house, foundations, pool and supporting structures. At the time of the first site visit in April 2015, the pool was covered which prevented observation of anything other than the surrounding concrete deck. A follow-up visit conducted on August 26, 2015 provided an opportunity to observe the pool beneath the cover.

4.1.1 Pool House Condition Assessment

The existing pool house consists of a two story main structure, and a one story addition that appears to have been built at a later date (*see Photo 1, Appendix A*). The pool house is recessed into an embankment so that the south-facing grade rises to the second floor level (*see Photo 2, Appendix A*). The grade rapidly descends around the sides of the pool house and meets the first floor elevation on the north side. Concrete masonry bearing walls provide support for the second floor and roof. A concrete slab on grade serves as the floor on the first level. The second floor consists of a concrete slab on steel deck supported by steel joists spaced at approximately two feet on center. The roof of the main pool house is constructed of timber trusses spaced approximately ten feet on center. Wooden purlins span the trusses and support planks running from the eve to the ridge. The one story addition utilizes prefabricated wooden roof trusses made from dimension lumber and spaced at approximately two feet on center. Plywood roof sheathing forms the decking between the trusses on this portion of the structure. The pool house structure is presumably supported on spread footings bearing on native soils although this could not be visually confirmed in the absence of as-built drawings. It is important to note that at this point not knowing the specific foundation type is not significant. It is very likely that the foundation consists of spread footings, and the stepped cracking in the east wall of the two story main pool house building is consistent with foundation settlement. At this time, further investigative work to expose the existing foundations to confirm the system is not warranted.

The primary structural issue with the pool house is the south basement wall that retains approximately ten feet of soil. It is evident the exterior waterproofing has failed and water has seeped through and degraded the wall materials. Additionally it appears that at some point, the wall began to fail and tie backs were installed to restrain the embankment and prevent the wall from deflecting inward. Currently the tie backs appear to be serving their intended purpose, with no visible deflection of the wall evident.

Significant stepped cracks were observed in the east wall of the two story pool house at the connection between the main structure and the one story addition. The cracks propagate at slab level from the northeast corner and extend diagonally upward to a window near the center of the building. This type of cracking typically indicates the underlying foundation is settling unevenly. An examination of the roof framing in this area revealed a wooden ledger at eve height pocketed into the corner of the original building wall. The header supports a portion of the added roof load which is in turn transferred to the corner of the original masonry wall. This additional load on the existing foundation has likely resulted in settlement of the corner footing for the original building, thereby resulting in cracking in the east wall.

As with any structure of this age, isolated cracking in the slab on grade and concrete masonry walls is expected and was observed at various locations throughout the pool house. This cracking is cosmetic in nature and is typically easily repaired. While these issues do not indicate a concern regarding the structural integrity of the pool house, they are unsightly and compromise the ability to maintain paint, caulk and other finishes on the wall.

4.1.2 Pool Deck Assessment

The pool deck is comprised of a concrete slab on grade and forms the perimeter of the pool area. It is evident the deck has been repaired previously with areas that have been patched, and cracks that have been routed and filled with a sealant. Some settling of the pool deck was visible and has resulted in uneven joints in numerous locations. In several areas, the concrete spalled off the top of the slab exposing the steel reinforcement beneath. These cracks appear to be recent and likely occurred after the previous repairs were performed. On the north edge of the pool deck there are limited areas where the soil beneath the deck has eroded, leaving the slab unsupported.

4.1.3 Pool Basin Assessment

At the time of the visit on August 26, 2015, the pool was completely covered. The cover was removed at two locations, one for a distance of approximately 50 feet along the south side and the other approximately 30 feet along the east side at the deep end of the pool. The pool is filled with water to within approximately 16 inches from the top of the coping, which limited our ability to observe the pool basin. The upper 16 inches exposed to view consists of a 2 inch coping, 8 inch ceramic tile and 6 inches of the concrete pool structure. No cracking was observed in the very limited portion of the exposed pool structure, other than at the location of the expansion joint near the reentrant corner extending into the deep end of the pool.

Cardno's scope of work did not include a detailed assessment of the existing pool basin. In order to perform this task, the pool would need to be completely drained to expose the remainder of the walls and floor. Additionally, since two detailed assessments were previously conducted, including non-destructive testing and concrete core sampling, a third detailed assessment is not warranted.

Prior assessments on the pool (Kimley Horn, 2014 and Camp Dresser & McKee, 2001) indicate the following:

> Date of original construction of the pool is estimated to be 1958.

> A new concrete liner was installed inside the existing pool in 1978, which consists of a 5-1/2 inch thick concrete slab cast on the floor of the pool, and 7-1/2 inch thick gunite on the walls.

> The CDM report included a detailed structural assessment consisting of visual observation, hammer sounding, non-destructive testing (sonic/ultrasonic techniques and ground penetrating radar), and concrete core sampling.

> Cracking existed continually throughout all walls of the pool within approximately the top 3 to 4 feet.

> The majority (approximately 80% to 90%) of the walls within the top 3 to 4 feet exhibited subsurface delamination under hammer sounding.

> The top portions of the pool walls (down approximately 4 feet below the top of the wall) have experienced significant structural deterioration. Repair of the upper part of the 1978 liner walls is not considered feasible due to the extensive delamination encountered.

> No significant cracking, spalling, subsurface delamination, or other structural deterioration was observed in the floor of the pool, or in the walls below the three to four foot depth.

4.2 Structural Observation Findings

4.2.1 Pool House Repairs (Structural only)

While no conditions were observed that represent a threat to life safety, several repairs are recommended to extend the pool house's usable life by any significant margin. From a structural standpoint, the most costly repair would be the retaining wall at the back of the building. While the previous repairs succeeded in keeping the wall in place, they do not address the cause of the problem which is the failed waterproofing system. To properly repair the waterproofing, the soil at the back wall of the building would need to be removed to install a drainage board and a perimeter foundation drain. Since the back of the pool house is relatively close to the property line, a temporary excavation support system may be required because it may not be possible to do a stepped excavation. There may also be utilities under the driveway which could complicate the excavation. Also, the tie backs laterally supporting basement wall would need to be reinstalled unless other measures are implemented to reinforce the existing masonry wall.

Although the utility survey conducted for this assessment did not detect buried utilities beneath the patched pavement, there remains a possibility that a non-metallic pipe or conduit may exist in the sub grade. Further investigation involving exploratory excavations are needed to verify the existence of buried utilities in the area.

Estimate of probable cost to provide repairs and install foundation drain: $75,000 - $100,000

Repairs to the stepped cracking in the existing wall at the northeast corner of the pool house will require measures to prevent additional settlement of the foundation. This could be achieved by installing helical piles to support the existing footing or by widening the wall footing by doweling new reinforcing bars into it and placing additional concrete. To install either option, the slab on grade would need to be removed, and excavation to the bottom of the existing footing would need to be performed. The slab on grade would then need to be locally reinstalled in the affected areas. Repairing the various cracks present in the slab on grade would involve routing the cracks and filling with a flexible joint sealant. The cracks in the concrete block walls would need to be repointed.

Estimate of probable cost to provide repairs to walls: $35,000 - $40,000

Aside from the repairs that are outlined above, additional structural renovations would be required to bring the facility into compliance with the ADA. The scope of these renovations is outlined within the Architectural portion of this report.

4.2.2 Pool Deck Replacement

Restoring the pool deck to a serviceable condition would require patching localized areas where the concrete cover has spalled off and repairs to major cracks in the concrete. However, as outlined in section 4.2.2, the entire pool deck will need to be replaced to comply with ADA requirements and to access the underlying drainage system. Therefore renovation of the deck is not deemed possible in the context of the other required renovation.

Estimate of probable cost to demolish and replace the existing pool deck is estimated at $50,000 for demolition and $100,000 for replacement. This item is also discussed in Section 4.2.2.

4.2.3 Pool Basin Replacement

There is compelling evidence in the prior assessments that the pool basin, which consists of the original structure (1958) and a new liner (1978), has exceeded its useful life and warrants replacement. Although both assessments indicate the existing floor of the pool is sound, in our opinion, a total replacement of the pool basin is warranted. While it may be possible to dowel in new reinforcement to the existing floor of the pool, additional costs will be required to protect the existing floor during demolition of the pool walls and construction of the new walls. The total savings achieved by utilizing the existing floor will likely not justify the value of total replacement of the entire pool basin.

We understand the Myrtha Pools “RenovAction System®” is being considered for replacement of the pool walls. The RenovAction® System is a pre-engineered modular system which utilizes stainless steel wall panels protected with a PVC membrane that would be installed inside the existing pool structure. The panels are intended to be supported on the existing floor of the pool and the upper portion of the existing walls of the pool would be replaced to accommodate the new gutter system. The top surface of the existing floor would be covered with a “Softwalk” foam mat and a protective PVC membrane.

It is evident that damage to the PVC coating on the stainless steel panels, which is inevitable in an outdoor public pool, will expose the panels to chlorinated pool water and result in corrosion. In addition, issues regarding attachment of the stainless steel walls to the existing floor of the pool that is 37 to 57 years old may require partial removal and replacement with a new concrete floor to support the new liner. A detailed evaluation of the RenovAction System would be required in order to confirm the appropriateness for this approach.

In addition, the gutter system and recirculation plumbing would also require replacement since the existing system is of insufficient size to meet current pool water changeover requirements.

Estimate of probable cost to demolish and replace the existing pool basin with an in-kind concrete pool is estimated at $736,067 to $763,989.

4.2.4 Wading Pool Replacement

Based on the extent of the repairs to the main pool basin and size of the wading pool, total replacement is recommended.

Estimate of probable cost to demolish and replace the existing wading pool: $65,000.00

5 Architectural Assessment

5.1 Pool House Condition Assessment

5.1.1 Architectural Components

Slab on Grade

The ground floor consists entirely of concrete slab on grade construction with no finish material. No significant displacement or settling was observed. Significant reworking of the slab should be contemplated in consideration of improved and/or relocated toilets and showers.

Estimate of probable cost to provide a partial demolition of the slab and an improved slab after other under-slab improvements have been made – those costs noted elsewhere: $10,550.

Exterior Walls

Existing two-story walls are painted concrete masonry units, including some decorative block at each gable end. Numerous openings in the walls accommodate vents, louvers and miscellaneous equipment, some are still in use and some are previously abandoned. An on-story addition and infill constructed to accommodate pumps and storage at the east end of the pool house are of a generally lesser quality. Some modest displacement was observed and should be repaired and filled as required prior to repainting. Deterioration of caulked joints in wall openings was observed adjacent to some doors and windows (in as much as new doors and windows are recommended throughout, no solution is proposed for this condition).

Estimate of probable cost to provide repairs and improve exterior wall systems: $20,700.

Windows

Window openings are on the south and north elevations and typically span from structural column to column, filling the bay. Window units (12 total) are typically combination units, comprised of aluminum fixed and sliding sash. Units are single glazed, numerous units were observed to have had their original glass replaced with Plexiglas. Units appear to have originally been trim-less, though some now have painted wood trim, presumably to hide displacement or function as stops for the retro-fitted plexiglass. Complete replacement of all window units (428 SF) is recommended.

Estimate of probable cost to provide the necessary demolition of existing and installation of new window units: $36,350.

Exterior Doors

Doors were observed to be painted metal, all original to the 1958 construction. Doors (4 total) were modestly deteriorated; some were outfitted with (non-code compliant) hasp. Most doors were exceptionally wide but also shorter than allowed by current code. Complete replacement of all door and frame assemblies is recommended. The most significant issue associated with the doors is a code issue associated with the uneven landing condition at the exterior of each doorway. For both entry and most importantly emergency egress all door are required to have an essentially level landing outside of each doorway. At this facility doors were built several inches higher than the adjacent grade (likely to prevent moisture intrusion at the sill) and subsequently sloped threshold were poured at the exterior. Hard surface improvements required by ADA repairs should address these issues. All door hardware, both interior and exterior are non-compliant round knobs. Replace (9) metal door hardware sets with compliant hardware.

Estimate of probable cost to demolish and renew door assemblies: $17,505.

Roofing

Prefinished metal roofing was reported to be approximately 10 years old; no leaking was observed or reported. Standing seams are outfitted with snowguards. Rust and corrosion was observed in most field panels and edge conditions. Significant renewal (to include removal of all rust and painting of the complete system) should be contemplated in the next five years. Roof consist of 2,200 SF of metal roofing and 294.5 LF of edge and ridge condition.

Estimate of probable cost to renew the roofing system: $39,250.00

Interior Partitions

Partitions include both painted gypsum board on wood stud and CMU. No significant deficiencies were observed. However, other proposed improvements will presumably necessitate the partial demolition of existing partitions and replacement at accessible toilet and shower improvements and interior accessible route improvements. It is advisable that wood-based wall systems be replaced with galvanized steel framing and water-resistant sheathing. It is expected that replacement with a steel system may reduce the cost by five to six percent over wood.

Estimate of probable cost to provide necessary partial demolition and improvements to the interior partitions: $10,260.

Specialties

A non-code compliant attic access stair is installed in the upper level public space, with no restrictions on its use. The owner should provide a code compliant ladder which is secure from unauthorized use. Metal toilet partitions throughout were observed to be old and damaged. They have been field painted in an attempt to visually improve them, but abuse and poor functionality were still evident. The partition systems should be totally replaced.

The locker/ toilet/ shower spaces, as they currently exist, lack any storage, lockers or cubicles for the swimmer's property while they swim or shower. It would seem to be an appropriate addition to add this type of storage in an improved facility.

Estimate of probable cost to provide attic access, new toilet partitions and appropriate guest locker system: $31,990.

Wall Finishes

Ground wall finishes primarily consist of paint on both the gypsum board and the CMU partitions with some rough-sawn plywood (painted) wainscot. Numerous walls have been damaged by moisture intrusion, displacement, and abuse. Although these finishes can be renewed, it may be more appropriate to consider enhanced finishes (4,200 SF) given the level of improvements associated with the other constructive improvements. Upper level has substantial ghosting of fastening systems and sheet seems, as well as scratches, dents and holes. Substantial repair of that system with an imperial finish plaster system (1,120 SF) or some type of partial hard coat finish system such as a fiberglass reinforced polymer (*FRP*) material is warranted at that location. The utility and storage rooms should be finished with a similarly damage resistant system (720 SF) but may not require the level of quality warranted in the public spaces. The new toilet rooms on that level should receive a ceramic tile wainscot, if not complete ceramic wall systems (384 SF).

Estimate of probable cost to improve interior wall finishes: $43,700.

Floor Finishes

The lower level is an unfinished concrete slab and the upper level is 12” x 12” vinyl composite tile (*VCT*). Any improvement to the pool house would likely include a new finish system (1,495 SF) on the ground floor slab necessitated by the trenching of the existing slab to provide for the necessary plumbing improvements. Additionally the new finish should improve the visual appeal of the spaces and their ability to be adequately cleaned and sanitized. The upper floor VCT is in poor condition with substantial loss of tile and numerous areas of poor repairs. VCT is not an acceptable floor finish in the toilet rooms on that level as evidenced by its deterioration. Instead consider ceramic tile or poured mineral aggregate epoxy impregnated resin for that installation. Complete replacement of the VCT floor finish (1,495 SF) is recommended.

Estimate of probable cost to improve interior floor finishes: $31,600.

Ceiling Finishes

Ceilings are predominately a hard painted gypsum board on the ground floor and 2’ x 4” vinyl faced acoustic ceiling tiles on the upper level. On the upper floor, the grid is bent and faded, tiles are aged with substantial rips and sags. Replacement of the entire system (1,120 SF) is appropriate. On the lower level, the ceiling system will likely be substantially removed to allow the wall reconfiguration, and the installation of new lighting. All ceilings should be replaced with mold-resistant gypsum board.

Estimate of probable cost to improve interior ceiling finishes: $12,010.

Total Estimate of probable cost of all proposed architectural improvements: $253,915.

5.1.2 Mechanical Components (HVAC and Plumbing)

HVAC

The heating and air conditioning system presently consists of four (4) through-the-wall packaged heat pumps, each sized at approximately 1 ton, located in the community room. Two of the units were reportedly replaced in 2013. The remaining two units, installed in 2003, have approximately 2 years of service remaining. There are also two (2) 5KW electric unit heaters in each of the upstairs bathrooms. Although the units are functioning properly they appear approximately 15 years old based on their condition.

The downstairs pool house area, which experiences seasonal use (summer only) is not provided with heat or air conditioning. There are several small wall exhaust fans which have essentially reached their service life and should be replaced with newer units. A modification was also made to the windows in the small office downstairs to allow for two (2) small ventilation units to be installed. With the replacement of the windows, it is recommended that a small half-ton through-the-wall heat pump be installed in this space for cooling.

There are also two (2) exhaust fans installed elsewhere within the facility. One is an attic exhaust fan installed in the end wall of the upstairs, and one is a small wall exhaust installed in the pool pump house located on the first floor. Both of these should be replaced as well due to their age and condition.

Estimate of probable cost to improve the HVAC system: $19,265

Plumbing

The plumbing systems include replacement of all fixtures and associated piping within the facility. The pool system is addressed separately. Based on the existing number of fixtures within the facility, the maximum allowable capacity is 575 (375 male and 200 female). This is based on the International Plumbing Code, Table 403.

The upstairs bathrooms have a total of two water closets, two lavatories and one urinal. These are proposed to be replaced with handicap fixtures, with the urinal being removed entirely due to the size of the new fixtures and limited space available in the men’s restroom. The cost for doing this work is included with the ADA Improvements cost that follows this section.

The downstairs portion of the facility has a female and male locker room, each with four (4) showers, four (4) water closets, and two (2) lavatories. The men’s locker room also has two (2) urinals. Each locker room will have one shower, one water closet, and one lavatory replaced with ADA compliant fixtures. The men's locker room will also have one urinal replaced with an ADA compliant fixture. It is recommended to replace the remaining existing water closets, urinals and lavatories with new units to match styling and functionality of the new handicap fixtures.

The existing showers are currently constructed of shower heads, drains, control valves and concrete block partitions allowing for no privacy in either locker room. It is recommended that these showers be upgraded in alignment with the other new fixtures. The walls should be removed and new stand-alone fiberglass shower compartments installed.

There is presently no service sink in this facility but it should be equipped with one. There is also no emergency eye-wash/shower unit installed in the chemical storage room.

Cardno was unable to inspect the condition of the service line entering the facility and no as-built drawings were available to determine the piping diameter. However, RCPA reports several failures over the last years suggests replacement may be needed.

Estimate of probable cost to improve the Plumbing: $34,669.

Total Estimate of probable cost of all proposed mechanical improvements: $73,934.

5.1.3 Electrical Components

Electrical service is provided to the pool house through an external masthead serving a meter box. The main electrical panel is located in the utility room on the top floor of the building. There is relatively new 200-amp panel that serves several smaller lighting panels as well as a sub-panel on the lower floor in the pool house. Lighting is provided primarily by either two-tube or four-tube T8 lamped fixtures, mounted on the ceilings. The lower floor area has numerous incandescent fixtures which are old and should be replaced.

The top floor has two (2) emergency lights mounted at each end of the assembly room, one of which is no longer operable. Since they are both of the same age, they should be replaced. There are no emergency lights present in the lower level but they should be installed. There are four (4) exterior metal halide light fixtures attached to perimeter of the building. Some of these are broken, and all appear to be somewhat deteriorated, requiring replacement. Other area lighting is provided by pole-mounted high-density lighting and appears to be in satisfactory condition. It is recommended that emergency lights be replaced with higher efficiency LED fixtures.

Without any guidance on future facility use, there is no indication that renovation or replacement of the pool house building would increase electrical demands. The current system adequately handles the current demands. In the event HVAC, lighting and other fixtures are replaced with more efficient units as part of a renovation, it is safe to assume an overall reduction in demand assuming the same building size and usage. However, a contingency cost of $5,000 is assumed in the event future pool system upgrade require additional electrical service capacity.

Estimate of probable cost to improve the electrical components: $16,988.

Pool Pumping Equipment

Cardno's assessment of the pool and pumping/filtration equipment was based on interviews with the City's pool maintenance contractor, Mr. Victor Adrion of Pool Service Company and on observations made during the site visits.

The existing pool supporting equipment includes two tanks, a sand filter with pump, a circulating pump and associated piping. This equipment has not been operational in almost a year due to the pool not being opened this season. With the exception of the sand filter, all of the components are approximately 40 years old, and while appearing to have been well-maintained, they are showing signs of moderate to severe deterioration. All flanges/fittings are corroded, some piping is leaking, and according to the manager, the larger pump has been rebuilt several times. Moreover, it was reported that the existing recirculating system in not capable of meeting current changeover requirements. It is recommended that the existing filtration/recirculation equipment will require a complete overhaul or even replacement.

Regarding the pool itself, there appears to be a leak in its containment walls and/or plumbing. When the facility is operational, fugitive pool water reportedly emerges from seeps at the base of a retaining wall behind the down-gradient townhouse development. A much more detailed analysis/study needs to be conducted to determine the location/extent of leaks and subsequent cost of repairs.

Estimate of probable cost to improve the pool drainage and pumping components: $118,500

5.2 ADA Evaluation

5.2.1 Site Access

From 2010 ADA Chapter 2 206.2.1 - Site Arrival Points.

At least one accessible route shall be provided within the site from accessible parking spaces and accessible passenger loading zones; public streets and sidewalks; and public transportation stops to the accessible building or facility entrance they serve.

Exterior Accessible Route

No exterior accessible route is currently provided from a public transit stop, from accessible parking, from a passenger loading zone or from the public sidewalk located adjacent to the property along Landover Street. The primary sidewalk currently providing access to the facility from the street has steps, slopes and cross-slopes that exceed the maximum allowed and are displaced in such a way as to create tripping hazards. The grade between the sidewalk (at the street) and the ground level of the pool house could easily allow for the construction of a compliant, accessible sidewalk.

Passenger Loading Zones

No passenger loading zone is currently provided at the site. At a minimum one accessible loading zone should be provided that would connect with the accessible sidewalk previously proposed.

Vehicle Parking

No vehicular parking is currently provided on site for the general public. Accessible parking is not required if no other parking is provided.

Sidewalks

Sidewalk approaches from any direction, off-site are non-compliant relative to the ADA code. It is beyond the scope of this study to address that issue. However, the provision of an accessible loading zone would seem an absolute minimum solution.

Exterior Stairs

The existing exterior concrete staircase is non-compliant relative to uniformity of riser height and tread depth. Any future improvement to this site should provide a new stair constructed of either steel or concrete.

Additional site amenities, including benches, picnic tables and trash receptacles are all typically non-compliant and they are not located on an accessible exterior route as required.

Estimate of probable cost to provide a compliant, accessible sidewalk from the edge of property to the existing pool house, a compliant passenger loading zone and a new compliant exterior stair connecting the two levels: $90,400.

5.2.2 Outdoor Activities

5.2.3 Swimming Pool and Wading Pool

As previously discussed, the exterior accessible route is non-compliant, similarly the routes to and around the pools are non-compliant. In an effort to maximize the drainage of the decks all have significant positive slope towards drains, cross-slopes of up to 6% were observed. Slopes are allowed up to 5% on a deck like this. However cross-slopes should not be above 2%. Inasmuch as the condition is meant to allow someone to go anywhere on the deck, for full and compliant accessibility no slope should be in excess of 2%. Constructing a perimeter drain system would eliminate the need for internal drains and reduce slopes over the entire deck to within ADA limits.

From 2010 ADA Chapter 2 242.2 Swimming Pools.

At least two accessible means of entry shall be provided for swimming pools. Accessible means of entry shall be swimming pool lifts complying with 1009.2; sloped entries complying with 1009.3; transfer walls complying with 1009.4; transfer systems complying with 1009.5; and pool stairs complying with 1009.6. At least one accessible means of entry provided shall comply with 1009.2 or 1009.3.

No accessible entry is provided at either the swimming pool or the wading pool (which, by exception only requires one). Provide compliant entry improvements to the each of these pools as required by code.

Estimate of probable cost to provide a compliant, accessible deck around each of two pools and some combination of compliant lifts, sloped entries, transfer walls, transfer systems and/or pool stairs: $150,000

5.2.4 Pool House

From 2010 ADA Chapter 2 206.2.4 Spaces and Elements.

At least one accessible route shall connect accessible building or facility entrances with all accessible spaces and elements within the building or facility which are otherwise connected by a circulation path…

Interior Accessible Route

The interior accessible route is insufficient relative to width, obstructions and headroom.

Shower Facilities

Showers are non-compliant relative to location, design, size, approach, grab bars and controls. At least one fully compliant, accessible shower is required for each gender, potentially an accessible “family” shower (allowing for the assistance of a family member) would be appropriate.

Dressing and Locker Rooms

Dressing Rooms are non-compliant relative to location, design and dimension. The benches in each of the dressing areas are non-compliant as are the mirrors and the coat hooks. One fully compliant dressing area should be provided in each of the two dressing rooms.

Drinking Fountains

No ADA compliant drinking fountain is provided. A fully compliant high/low accessible design fountain is required.

Entrance Doors

Entrance doors were typically 3’ 6” wide, however the primary entrance door is only 6’ 6” high, the hardware and the threshold conditions were non-compliant. Provide four fully compliant entrances to the facility.

Signage

There is no compliant signage associated with the facility. Provide a comprehensive, fully compliant signage package for the improved facility.

Single User Toilet Rooms

Toilet Rooms on the upper floor are non-compliant relative to access, design, size, fixtures, hardware, grab bars and controls. Provide two fully compliant single user toilets on the second floor, one for each gender. Also provide family changing rooms and/or areas. It is important to note that any reconfiguration of the building layout would involve additional costs. However, the costs provided here are estimates associated with in-kind renovation.

Multi-fixture Toilet Rooms

Toilet rooms on the lower floor are non-compliant relative to access, design, size, fixtures, hardware, grab bars and controls. Provide two fully compliant single user toilet stalls, one in each of the two dressing/shower areas, one for each gender. Additionally provide an accessible, fully compliant urinal in the men's dressing/shower area.

Additional non-compliant features were identified with the interior functionality of the pool house relative to the ADA, including a lack of compliant fire alarm systems.

Estimate of probable cost to provide a comprehensive, fully compliant interior improvement package to include; interior accessible route ($90,400), shower/dressing/toilet areas for each gender, drinking fountain, entrance doors and signage ($80,160), building access ($140,470).

Elevator

From 2010 ADA Chapter 2 206.2.3 Multi-Story Buildings and Facilities.

At least one accessible route shall connect each story and mezzanine in multi-story buildings and facilities.

EXCEPTIONS: 2. *Whereas two story public building or facility has one story with an occupant load of five or fewer persons that does not contain public use space, that story shall not be required to be connected to the story above or below.*

In a best case scenario an elevator would connect the two floors of this facility. If the functions of the two floors were so disassociated that no one would ever go from one level to the other the argument could be made that accessible entry for each is provided independently to each level. However, accessible access to the upper level will be a challenge. A compliant access at the lower level with an elevator would be a good way to avoid that condition (and you might be able to eliminate one set of toilets room improvements).

Limiting the use on the upper level may be an option to eliminate the need for full compliance .However, this approach would require re-evaluating projected facility use.

Estimate of probable cost to provide fully compliant interior accessible route between the two floors of the facility by installing an elevator; $148,640.

5.3 Estimated Costs for Pool House

Since renovating the existing facility entails a substantial cost it would be prudent to consider several renovation alternatives such as including partial or limited expansion of floor space to accommodate program needs and/or to accommodate ADA-required facilities. However, it is outside the scope of this analysis to identify and address the multitude of possible replacement options. Nevertheless, given that the renovation cost, referred to herein as Alternative, is at or above the in-kind replacement cost, it seems appropriate to look at the probable cost of constructing a new pool house on this site rather than renovating the existing one. Two variations on facility replacement are presented: Alternative 2 - an in-kind replacement and Alternative 3 - a one-story replacement. The costs for all three options are presented here and detailed in Appendix C.

5.3.1 Cost Estimate for a Fully Renovated Pool House – Alternative 1

Cost estimates for pool house renovation are based on an in-kind renovation of the existing structure while maintaining the basic floor plan. In some instances, it may be necessary to reconfigure some spaces within the pool house to accommodate expanded facilities such as restrooms needed to comply with ADA requirements. However, the costs presented in Table 1 otherwise assume maintaining the structure as it is currently configured. The renovation costs are broken into two major parts 1) pool house building renovation and 2) peripheral site work and improvements. The former figure includes all structural –related renovation costs from foundation to roof, including partial demolition, while the latter figure covers all costs including, site work, regrading, utilities and landscaping (see detail in Appendix C).

It is also important to point out that the costs presented here are derived from published unit costs or in some cases estimates provided by those familiar with renovating similar structures. In any case such estimates may exclude important items or retrofits that extend from having to repair or alter underlying or associated structures. Consequently, there may be ancillary costs that cannot be specifically accounted for here without undertaking a more detailed design process that considers these limitations. For example, if moving a wall to provide required clearances needed to accommodate ADA-compliant toilets creates the need to alter load-bearing walls or to reconfigure underlying sewer connections, the full cost of the alteration cannot be accounted for without a more detailed architectural and engineering study. Therefore all retrofit costs should be regarded with a higher level of uncertainty than if a new structure was being considered.

Estimate of probable cost to renovate the existing facility to create a fully ADA compliant pool house, including architectural, mechanical, electrical and pool pumping equipment including the installation of an elevator: $1,076,479 to $1,237,951.

5.3.2 Estimate of Cost for Replacement Pool House – Alternatives 2 and 3

Researching construction cost for similar bathhouse and community center projects, Cardno identified a range of square-foot costs between ranging from $160.00 to $248.00. These estimates are in turn are utilized here to estimate costs for constructing Alternative 1 (two-story in-kind replacement) and Alternative 2 (one-story replacement) on the Warwick site as shown in Tables 2 and 3 repsectively. It is expected that in either case, a substantial regrade, correcting drainage issues, installing a retaining wall and adding an elevator for ADA compliance would push the probable Alternative 2 cost to the high end of the ranges. Demolition costs included here assume an average level of hazardous materials (ACMs and LBP) will be encountered for both alternatives. It is also assumed that water and sewer lines would be upgraded/replaced as a part of new construction in either case.

One of the chief advantages of building a new facility would be to realize the opportunity to configure the design to meet the needs of the community as closely as possible including adjusting the size and arrangement of the interior spaces. The issues associated with providing access to the second floor suggest a one story building might provide better access to all users and eliminate the need for an elevator. However the site grade would require considerable modification and requiring the construction of substantially higher retaining walls (10-12 feet) along the southern perimeter at an estimated additional cost of $81,297. This and related improvements would likely offset more than half of the cost of an elevator estimated at $148,640 However, the added benefits of a one-level facility in terms of ease of access would be realized.

Estimate of probable cost to provide fully ADA compliant pool house facility, including architectural, mechanical, electrical including installing an elevator $867,695 to $1,225,236 for Alternative 2 (two-story, in-kind) and $583,992 to $785,334 for Alternative 3 – one story replacement.

6 Geotechnical Investigation

6.1 Subsurface Exploration

As a part of the site evaluation, Cardno tested subsurface conditions by advancing seven auger borings and conducting Standard Penetration Test (*SPT*). The testing characterized the substrate materials and conditions beneath the site and aided in identifying limitations for site redevelopment. The study is of limited scope and is intended to support planning and decision making rather than as a basis for fully designing a future facility. Any future design should be supported by a detailed follow-up geotechnical evaluation configured to address the proposed facility layout. Costs for addressing geotechnical issues are included in the per-square foot basis for estimating a replacement building.

The approximate locations of borings advanced at the site are indicated in *Figure 2 – Boring Location Plan*. Seven soil test borings (B-1 to B-4 and P-1 to P-3) were advanced for this project using a truck-mounted drill rig with 3 ¼" Hollow Stem Augers (*HSAs)*. The borings were advanced to maximum depths of 25 feet below existing grade. SPT testing was conducted utilizing an automatic hammer at closely-spaced intervals in the upper 10 feet and at 5 foot intervals thereafter. The slab cores were backfilled with a non-shrink grout and excess spoils were hauled off-site. Details of the testing methods utilized by Cardno are provided along with boring logs and recommendations for undertaking further design work and construction testing in *Appendix B.*

6.2 Subsurface Conditions

In the area of the proposed development, the test borings have encountered three (3) strata within their termination depths as described in the following paragraphs:

> **STRATUM A (UNCONTROLLED FILL)** was encountered at test borings B-1 through B-4 beneath a surficial layer of approximately 4 to 5 inches of concrete and 9 to 10 inches of stone base, Stratum A was sampled as a mixture of clay, silt and sand with some gravel and concrete fragments. SPT resistances in the Stratum A Fill soils ranged from 2 to 9 blows per foot (*bpf*).

> **STRATUM B (POTOMAC CLAY)** was encountered and sampled in each of the borings at a depth of about 6 feet in the pool deck area (approximate elevation +68 feet) and immediately below the asphalt entrance road and was classified as medium stiff to very stiff brown and gray silty clay (CL and CH). SPT N values generally ranged from 5 to 18 bpf.

> **STRATUM C (POTOMAC SAND)** was encountered beneath the existing Stratum A fill soils at test borings B-1 to B-4 and P-3 and beneath the existing pavement section at boring P-2. Stratum C was sampled as medium dense to dense brown and gray clayey sand (SC). Looser portions with SPT N values ranging from 6 to 9 were encountered at boring P-2 to a depth of 5 feet below ground surface (*bgs*).

Groundwater was encountered at test borings B-1, B-3 and B-4 at depths ranging from approximately 1.8 to 2.9 feet and at test boring B-2 at a depth of 12.9 feet below existing grade and also at boring P-2 at a depth of approximately 1.1 feet below existing grade.

6.3 Foundations

6.3.1 Spread Footings

Because Stratum A fill soils appear to have been placed in a loose, uncontrolled manner they are unsuitable for direct foundation support. In addition, looser/softer areas of the existing Stratum B soils underlying the existing Stratum A fill are also unsuitable. Spread footing foundations will need to be undercut to bear upon competent Stratum B or C soils or newly-placed structural fill placed in accordance with the recommendations provided in this report.

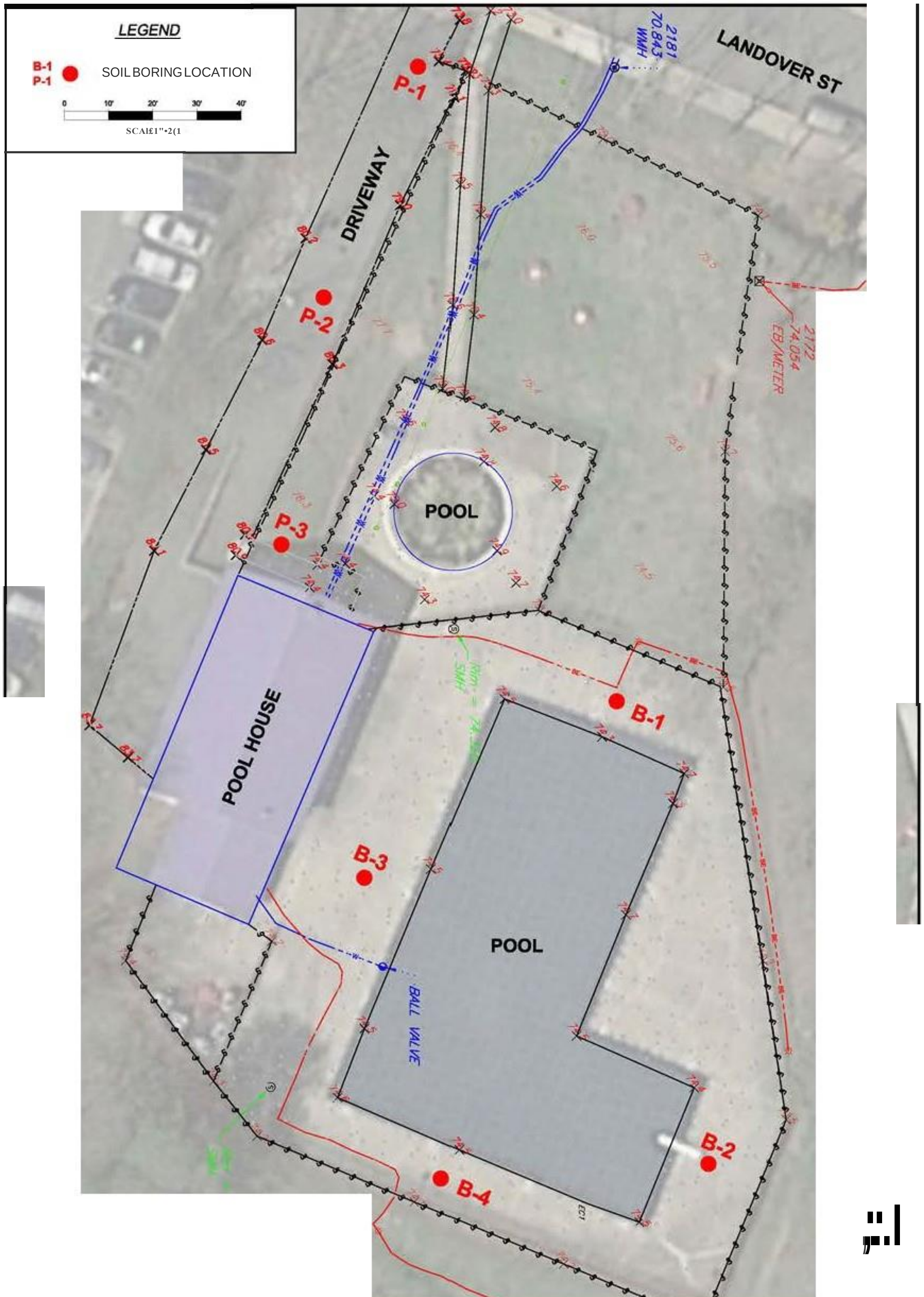


Figure 2	WaJWick PoolFacility [redacted] Alexandria, Virginia Site Map showing Borehole Locations

Spread footing foundations should be designed for a maximum allowable bearing pressure of 2,500 pounds per square foot (*psf*). Maximum total and differential settlements on the order of 1.0 and ½ inch are anticipated.

6.3.2 Helical Piles

We understand that a stainless steel pool liner structure is being considered for the site in lieu of removal and replacing of the existing concrete pool. It is our further understanding that the steel liner will be supported by a series of helical piers. To provide adequate support for the proposed pool liner, we anticipate that helical piles extending on the order of 10 to 15 feet into the Stratum C clayey sand layer could achieve a design capacity of 25 kips per pile. As a preliminary design, the helical piles should have 14-inch helical flight plates, a minimum 2 7/8 inch diameter pipe with 0.25-inch wall thickness, and 10 foot bolted extensions with grouted shafts. The helical pile installer should use their system to develop the final design details.

6.3.3 Structural Fill

The existing fill materials of Stratum A and silty/clayey sands of Stratum C both contain locally elevated levels of fines (silt and clay) and should be considered to be moisture-sensitive in nature. The feasibility of re-use of Stratum A and C soils as structural fill on-site beneath foundations, pavement and slab subgrades, and in fill embankments is strongly dependent upon weather conditions and the ability of the contractor to prevent the deterioration of existing soils. It should be anticipated that the Strata A and C soils may require moisture control measures prior to re-use as structural fill. The clay soils of Stratum B are not expected to be suitable for re-use as compacted fill in structural areas, as the plasticity of these materials is excessive and are prone to excessive shrink/swell behavior.

6.3.4 Grade Slabs

The thickness of the concrete floor slab will depend upon the magnitude of the expected loading and should be designed by the Structural Engineer. A subgrade modulus (*k*) of 120 pounds per square inch per inch (*psi/inch*) is recommended for design purposes for the floor slab subgrade soils. We recommend that the concrete floor slab be supported on suitable soil founded upon a minimum 4-inch thick layer of No. 57 stone, Graded Aggregate Base (*GAB*) or other acceptable granular stone to distribute the concentrated loads, enhance drainage, and reduce degradation of the prepared subgrade during construction.

6.4 Temporary Excavation Support

Details concerning the proposed construction have not been provided to Cardno at the time of this report. However, if the existing two-story pool house is to be demolished and replaced by a new structure, a temporary excavation support system must be utilized to laterally restrain the sides of the excavation and limit the movement of adjacent hillside. Our experience with similar projects indicates that a temporary excavation support system consisting of soldier piles and timber lagging is the most economical system for the conditions at this site. Depending upon the depth of the excavation and design requirements, tieback installation may be required. If tieback installation is not practical due to the presence of obstructions, internal bracing may also be utilized at the discretion of the designer.

6.5 Site Seismicity

The Virginia Uniform Statewide Building Code (*VUSBC*) is adapted from the 2012 International Building Code (*IBC*). In accordance with IBC, Seismic Site Class must be evaluated based on the subsurface profile within the upper 100 feet of existing ground surface. The estimated subsurface profile and soil properties were based upon available geologic mapping and our experience with similar subsurface conditions in the vicinity of the project site. Based on our review of the available data, understanding of regional geology and the test boring results, the site is classified as Site Class E.

6.6 Existing Conditions Surveying & Monitoring

Due to the proximity of the proposed construction to existing buildings and improvements, we recommend that existing condition surveying of neighboring structures and a comprehensive monitoring program be implemented. We recommend that a specialty firm(s) be engaged to provide pre- and post-construction condition surveying and construction monitoring for the project site.

7 Hazardous Materials Assessment

7.1 General

Hazardous materials commonly occur in building materials and within building spaces. This includes constituents of the building materials themselves such as asbestos containing materials (*ACMs*) and lead based paint (*LBP*) and in the fixtures such as mercury thermostats and electrical ballasts or transformers containing polychlorinated biphenyls (*PCBs*). Chemicals and substances used and stored within buildings are also of potential importance should they require removal and/or storage or disposal during renovations or demolition.

The prevalence of hazardous materials in buildings tends to increase with age and they are generally more widespread in structures constructed before environmental regulations were developed to control their manufacture, use, handling, transfer and disposal in the late 1970s and 1980s. Moreover, older building materials are often in poor or degraded condition and therefore pose a greater hazard when disturbed. In general, the prevalence of hazardous materials in building materials is greatest in buildings constructed prior to the early1980s although the common use of some offending substances continued into the 1990s and even later.

In many cases suspect hazardous materials are not harmful to occupants unless they are disturbed or damaged during renovations or demolition. Consequently, any plans to undertake activities likely to disturb older building materials should be preceded by inspections and testing to determine the type and extent of hazardous materials present. It is important and required that contractors and their workers be informed of the presence of hazardous substances in the materials they handle and that measures are taken to protect their health and that of surrounding populations. Federal and state laws also require the proper handling, transport and disposal of hazardous wastes.

No specific inspection of the Warwick Pool facility was undertaken to identify the existence of hazardous substances or materials in the pool house or in containers or other storage areas inside the structure. Consequently we can only make general inferences regarding their existence based on general knowledge of the age, type of construction and history of use. The following sections summarize potential issues that may arise during renovations or demolition at this facility.

7.2 Asbestos Containing Materials

The use of asbestos dates back into the 1800s as an insulation material for steam lines in ships. Its use in buildings followed and peaked in post-World War II era and continued into the 1970s. Common building materials containing asbestos include adhesives and mastics, ductwork, floor tile backing, drywall taping, thermal insulation, window glazing, roof sealants, electrical panels, fireproofing, boiler insulation, steam pipe insulation and countless others. In many cases these materials occur in older buildings and are often covered or sealed off by subsequent layers of non-ACM applied intentionally or inadvertently to seal off any hazard from exposure. However, any repair, renovating or demolition of older structures often involves disturbing these materials.

Asbestos exposure becomes an issue if ACMs become airborne because of deterioration or damage to building materials. Building occupants and bystanders may be exposed to asbestos but those most at risk are persons who purposely disturb materials such as maintenance or construction workers. Workers involved in disturbing ACMs are covered under numerous Federal and state laws and regulations including the Occupational Safety and Health Administration's (*OSHA*) asbestos regulations. OSHA covers the handling of ACMs in the construction setting under 29 CFR 1926.1001 and 1926.1101. Although it is beyond the scope of this evaluation to explain the requirements of these regulations it is important that government agencies contracting work involving the disturbance of ACMs recognize the potential hazard and alert contractors of their responsibilities under the law to protect workers and the public from exposure.

Given that the Warwick Pool facility was constructed in the late 1950s, it is not only possible but probable that some or even many of the materials comprising the structure contain ACMs. This includes all parts of the structure including the walls, floors, ceilings, roofs and spaces in between. It is likely that many of the ACMs are covered or hidden beneath more recent materials or coatings applied during renovations over the years. Determining the full type and extent of ACMs within the structure would require a full inspection to include sampling and testing of materials to confirm the presence of asbestos.

7.3 Lead Based Paint

LBP was banned in 1978 for use on residences or other buildings where occupants could be exposed. It was also phased out in industrial uses during the same period. Lead solder for water pipes was banned from use plumbing systems in 1988. However, since there was no requirement to remove or abate affected materials from older buildings many structures retain lead-containing materials, especially coatings of LBP. Construction employees are potentially exposed to lead primarily when they remove or disturb lead-based LBP as they undertake repairs or prepare surfaces for painting or repair on older buildings. Exposure to LBP also occurs during demolition as walls, floors, roofs and other materials are dismantled and the resulting dust becomes airborne.

The Virginia Department of Professional and Occupational Regulation (*DPOR*) administers regulations which establish entry, renewal and performance standards for firms and individuals engaged in lead-based paint activities. They also set approval and performance standards for firms offering training individuals who desire to become licensed to perform lead-based paint activities. In addition to regulation under OSHA’s Lead Construction Standard (29 CFR 1926.62), current state regulations apply to target housing (constructed before 1978), public and commercial buildings and superstructures. Licenses are required for lead contractors, workers, supervisors, inspectors, risk assessors and planner/project designers. In addition, the Virginia Safety and Health Codes Board adopted the Lead Notification Regulation VR 425-03-185, effective June 26, 1997. This rule requires all certified lead contractors who engage in lead abatement projects in Virginia with a contract value of $2,000 or more to notify the Virginia Department of Labor and Industry at least 20 days prior to commencing any work and to pay a permit fee with each notification. The rule exempts some lead abatement projects in certain residential buildings from fees, but notification requirements would still apply.

As with ACMs, the age of the Warwick Pool facility makes it likely that all or most of the surfaces are coated with multiple layers of LBP. Although most of these surfaces are likely recoated with non-LBP, disturbing, repairing or demolishing the structure would likely generate dust containing lead. Consequently, the presence and extent of LBP must be considered in preparing estimates for renovations or demolition. Potential additional costs could come from disposing lead-containing materials although it is unlikely the materials generated here would fail hazardous waste characterization tests.

7.4 Other Hazardous Materials

Commercial and government buildings utilize a wide array of chemicals for various purposes including cleaning, maintenance, pest control, fuels, lubricants, de-icers, odor control, refrigeration as well as others used in specialized processes as in the case of public pool operations and maintenance. Chemicals may be stored in their original containers, transferred to various vessels for storage and use or deposited in receptacles, drums or tanks after use. The type and disposition of chemicals remaining on site will determine whether they can be reused or transferred to other facilities, sold, surplussed or disposed as wastes. Because Warwick Pool is a non-residential facility, chemicals disposed as wastes are subject to Federal requirements arising from the Resource Recovery and Compensation Act (*RCRA*), which regulates their handling from cradle to grave.

Aside from the types of chemicals listed above, it is probable that an array of chemicals used in maintaining and operating Warwick Pool remain stored on site. These would include: water balancers sodium carbonate and soda ash, sodium bisulfate; alkalinity increasers such as sodium bicarbonate, muriatic acid and sodium bisulfate; calcium hardness increasers such as calcium chloride. The most important and probably common chemicals would include sanitizers containing chlorine, bromine and bi-guanide or polyhexamethylene bi-guanide. Also possible are algaecides such as quaternary ammonia, polyquats, metallic borates (sodium tetraborate, borax), bromine salts (sodium bromide); shocks and oxidizers including sodium di-chlor, calcium-hypochlorite (Cal-Hypo), lithium hypochlorite, sodium hypochlorite (bleach, liquid chlorine), non-chlorine oxidizers (mono-persulfate or MPS and potassium peroxy-monosulfate, a MPS substitute). Other supportive pool chemicals might include clarifiers, metal removers, stain & scale inhibitors, cyanuric acid (stabilizer).

In addition to stored chemicals commercial and government buildings generally contain one or more appliances considered universal wastes upon disposal. The federal universal waste regulations (49 CFR Part 273) include hazardous waste batteries, mercury-containing equipment, pesticides, and lamps. To be covered under the universal waste program, these items must first be identified as hazardous waste upon disposal. Items that still have product value and that are still being used are not wastes and, therefore, are not subject to RCRA.

The universal waste regulations define a battery as a device consisting of one or more electrically connected electrochemical cells that are designed to receive, store, and deliver electrical energy. This would include batteries found in back-up systems such as emergency lights, security systems and electrical control systems. Examples of common universal waste electric lamps include fluorescent, high intensity discharge, neon, mercury vapor, high pressure sodium, and metal halide lamps. Elemental mercury is contained in many types of instruments and devices that are commonly used in commercial buildings. Such devices may include thermometers, manometers, barometers, relay switches, mercury regulators, meters, pressure gauges, and sprinkler system contacts.

The method and cost by which pool-related or other chemicals are handled or disposed will first require a full inventory of the types and quantities of chemicals and items. Also of importance is the condition of the materials and/or their containers. It is probable that usable chemicals in their clearly labelled original containers in good condition could be relocated to other City facilities and re-used. Chemicals in poorly labelled or un-labelled containers, especially those in poor condition will require repackaging, over-packing, transport and disposal off site. In the event such chemicals are deemed hazardous, specific handling, labelling, manifest, transport and disposal regulations will apply. Likewise, chemicals already stored in on-site vessels or tanks will require pump-out and disposal per applicable regulations. Universal wastes would require proper handling and disposal as the building is dismantled. This is often handled by the demolition contractor but it is important that proper manifesting and recordkeeping protocols are being followed. Based on the observations made in the preliminary site visit and on queries directed to an experienced demolition contractor it is expected that the cost for addressing asbestos, LBP and other potentially hazardous materials on site could range between $8,000 to $12,000 for a renovation or a total demolition. Costs for addressing the same issues for renovation are very dependent on the actual design and the volume of materials to be removed or encapsulated but are estimated at around $8,000 to $9,000 due to the need for project planning and monitoring while workers are at risk for exposure. Costs for handling hazmat issues during a total demolition would be somewhat less but are included in the overall demolition costs presented here.

8 Conclusions

8.1 Summary of Pool House and Pool Basin Condition

While Cardno's inspection found no conditions precluding repair or renovation of the pool or pool house, the overall condition of the building was found to be no better than fair with most major systems at or beyond their expected service life. While a piecemeal or total repair of these systems is possible, it is clear that anything other than a major renovation will not return the building to long-term serviceability. Moreover, the need to reconfigure key architectural elements to comply with the ADA expands the extent and cost of necessary renovations, particularly with regards to key building access points and corridors.

Several structural issues were identified with the pool house including settling and cracking of foundations, floors and walls, ingress of moisture due to inadequate drainage and waterproofing of subgrade walls. Likewise, the aging materials of the pool and deck as well as issues with the underlying plumbing and drainage would limit the efficacy and durability of short term structural and mechanical repair.

All major electrical and mechanical systems were found to be at or well beyond their normal service life and in most cases would require total or near replacement to bring the facility into compliance with modern codes, restore system reliability and limit operating costs. In particular, this includes the pool and pool house mechanical systems including piping and pumps. Some pool components such as the sub-code recirculation system, deteriorated pipes and the lack of ADA-complaint access to the pools create significant obstacles to efficient repair. While these issues could be corrected with extensive renovations, the final costs and long-term efficacy would be uncertain due to poor access for inspection and the advanced age of any retained materials. Accessing many of these systems for inspection, repair or replacement will in many cases require the removal or cutting away of floors and pavements which themselves are in need of major repair or complete replacement. Additional hidden defects are likely to be encountered once renovations are underway and the restored patches will compromise the overall integrity of the structures.

While no major geotechnical issues were identified with the site substrates, the existence of two horizons (A and C) containing an excess of fines could prove problematic in developing suitable substrates for foundations. Moreover, testing conducted thus far only addresses accessible portions of the site and those beneath the pool house and pool basins could entail different challenges. More complete testing is only possible once the existing structures are demolished and the site cleared of debris. The design, construction or renovation of subgrade foundations and walls along the southern edge of the property will entail special consideration and should be overseen by a geotechnical engineer.

It is reasonable to assume that renovated structures that retain existing materials and equipment will be inherently less reliable than a total replacement. Moreover, the cost to evaluate and engineer renovations around old systems, particularly where they cannot be fully inspected (such as sub-grade piping beneath the foundations and pool floor) may exceed the cost of a total replacement. Over time, partially replaced systems will likely fail sooner than new systems and diagnosing points of failure are likely to be more difficult and costly over time. It is also worth noting that newer building systems can generally be more cost-effectively designed to a higher level of energy efficiency, resulting in lower operating costs over time. Consequently, even in the event the costs to replace or to renovate are equal, the life-cycle cost for the renovation will likely be higher due to increased maintenance and operating costs.

8.2 Discussion of Alternatives

This evaluation focused on two approaches to rehabilitating the Warwick Pool facility: 1) a full renovation of the pool, pool house and supporting infrastructure, or 2) the full in-kind replacement of both structures. While numerous variations on these two approaches are possible, the three most viable alternatives that emerged from our evaluation included: Alternative 1 – full in-kind *renovation*, Alternative 2 – full in-kind *replacement* (two-story pool house) or Alternative 3 – nearly full in-kind *replacement* but with a one-story pool house.

8.2.1 Alternative 1 – Full In-kind Renovation

It is the consensus of this and earlier assessments that considerable renovations are needed to return the pool and pool house to long-term serviceability. Renovation would include correcting all major structural and cosmetic defects, renewing and upgrading all mechanical and electrical systems to meet prevailing codes and reconfiguring interior spaces and exterior access to comply with ADA requirements. The renovation alternative necessarily entails accepting the existing facility's fundamental layout and design including any shortcomings along with the limited ability to cost-effectively correct these. Costs estimates for this alternative assume a pool refit using a Myrtha-type liner system but a full replacement of the circulating pumps, filtration, recirculation piping and pool deck.

It is possible that a hybrid alternative could be derived from combining the pool renovation proposed above with a building replacement. While the costs are lower for renovation, this alternative nevertheless involves outright replacement on many of the key system elements. A piecemeal renovation of any of these systems is not feasible given the components are already beyond their service life and anything other than a total replacement would degrade future reliability and efficient operation.

8.2.2 Alternative 2 – Full In-kind Replacement

Replacing the facilities would involve the total demolition of the pool, pool house and surrounding access and rebuilding the facility back to its current two-level configuration to meet community needs and comply with prevailing building codes. The design of a replacement facility may involve reconfiguring the pool house, pool basin and overall layout to better fit community needs. It is assumed that basic supporting infrastructure such as electrical, water and sewer connections may also require resizing. The cost estimates presented here assume an in-kind replacement of both the main and wading pools including all pumps, filtration, recirculation piping and deck. The replacement alternative considers conventional concrete-based materials will be used in reconstruction. As mentioned above, it is possible that hybrid alternatives could be developed to include renovating the pool with a Myrtha-type lining system but replacing the other key mechanical and peripheral systems. However, we do not recommend considering retaining any of these systems due to their advanced age and condition.

8.2.3 Alternative 3 – Nearly Full In-Kind Replacement – One-story Pool House

The City could also choose to modify the facility's mission to focus solely on water-sports. Abbreviating the size and scope of the facility mission presents the opportunity to reduce the building size, thereby reducing capital and operating costs. This reconfiguration could be most simply accomplished by reducing the facility to a one-story building constructed at a common grade with the pool deck, eliminating the second-floor community meeting space and restricting the first floor to seasonal aquatics center support. Restricting the facility to warm-weather seasonal use eliminates the need for installing heating and air conditioning. Deleting the upper floor also creates the opportunity to regrade all access on a common grade to comply with ADA grade/slope limits thereby eliminating the need for an elevator. It is important to note however that reducing the existing grade to create a more-or-less level street access would require a significant re-grade and construction of a substantial retaining wall along the southern perimeter of the property. The cost of the wall would, to some extent, offset a portion of the savings realized from reducing floor space, and eliminating the elevator and HVAC system. It is worth noting that most other costs for Alternatives 2 and 3, including demolition are essentially equal.

8.3 Summary of Costs

Costs for renovation and replacement were derived from Cardno's own inspections and experience with similar facilities, published estimates, from prior site-specific studies by other consultants and from queries directed at providers of key components. Cardno's own estimates are based on a step by step inspection and consideration of each architectural component including the type, age and condition along with empirically-based costs for repair or replacement. While Cardno was able to access most of the pool house building, access and visual inspection of the main pool basin was limited by the presence of water within 18 inches of capacity. Consequently much of the repair costs are based on our inspection of the visible portion, an interview with the pool service provider and descriptions from prior inspections performed by Kimley and Horn in 2014 and CDM in 2001. Costs for replacing the entire pool house and pool are based on empirically-based ranges for similar construction applied to the square footage of each. The renovation estimates are based on a site specific evaluation by a local pool company, Endless Summer Pools that is a dealer for Myrtha-type liner systems.

Other costs such as those arising from unforeseen site conditions or from addressing issues not covered in the inspections such as hazardous materials may play a minor role in the overall cost to renovate or replace the structures, depending on the approach taken. In general, the costs of managing hazardous materials is lower for a total demolition than a renovation as these materials are easier managed on a bulk scale rather than on a piecemeal basis.

8.4 Cost Analysis

A summary cost comparison of the three main alternatives is presented in *Table 1* below. A more detailed analysis of the cost basis of each alternative follows. Although it is possible to renovate all of the systems examined in our inspections the overall costs to restore the pool and pool house through a complete renovation is equal or somewhat higher than that of a full replacement.

Table 1. Summary Cost Comparison of Three Alternatives

Alternative	Low Range	High Range
Alternative 1 - In-Kind Renovation	$2,399,858	$2,759,837
Alternative 2 - In-Kind Replacement	$2,079,760	$2,744,481
Alternative 3 - One-Story Replacement	$1,671,938	$2,112,121

Cardno's assessments and cost estimates for renovations and full replacement basically corroborate those derived from the earlier report prepared by KH. KH's estimate for its Tier I through Tier III building renovations ranged from nearly $1.3M to almost $1.7M while Cardno estimated building renovations at between $1,076,479 and $1,237,951 for an in-kind pool house renovation and between $579,095 and $683,968 for re-lining the pool and replacing all key supporting systems (*Table 2*). The pool basin renovation costs assume a Myrtha-type relining system for the main and wading pools. It is estimated that designing the renovations recommended by Cardno would cost between $250,420 and $287,983. Adding in a 25 percent contingency to all of the above costs brings the full renovation cost estimate to between **$2,399,858** and **$2,759,857**. A more detailed breakdown of the renovation costs is presented the table presented in Appendix C.

Table 2: Summary of Alternative 1 Renovation Costs

	Estimated Cost of Warwick Pool Facility Total In-Kind Facility Renovation		
Alternative 1	**Component**	**Low Range**	**High Range**
	Pool House Renovation		
	Pool Building Renovation - Includes ADA Retrofits, Structural Repairs	$919,507	$1,057,433
	Peripheral Site Work and Improvements	$156,972	$180,518
	Total Pool House Renovation:	**$1,076,479**	**$1,237,951**
	Pool Basin Renovation		
	Partial Pool Demolition (Mechanical and Pool Deck)	$10,000	$11,500
	Pool Deck Replacement	$150,000	$172,500
	Pool Basin Renovation - Myrtha Type Liner System (main basin + wading pool)	$297,500	$342,125
	Pool Pumping and Filtration Equipment Replacement w/ Electrical	$135,488	$155,811
	Total Pool Basin Renovation:	**$592,988**	**$681,936**
	Total In-Kind Facility Renovation:	**$1,669,467**	**$1,919,887**
	Design Costs and General Conditions - percentage of construction costs (15%)	$250,420	$287,983
	Contingency - 25% of Design and Construction Costs	$479,972	$551,967
	Total In-Kind Renovation Project Total:	**$2,399,858**	**$2,759,837**

As shown in *Table 3* below, estimates for a full, in-kind pool house replacement ranges from $867,695 to $1,225,236 and between $579,095 and $683,968 for a new conventional concrete pool. These costs include complete demolition and disposal of the existing pool house structure including management of hazardous materials, and then completely replacing the building in a similar configuration. The pool replacement costs include full demolition of existing basin and drainage followed by replacement of the basins, pool drainage, circulation pumping equipment, filtration system, installing ADA compliance additions. Included in the building replacement are costs for undertaking peripheral site work such as stormwater management, landscaping, fencing, utilities upgrades and access improvements. It is probable that many of the costs for the peripheral items are equal or nearly equal in cost regardless of whether they are undertaken as part of a facility renovation or replacement. Adding design costs and general conditions of between $217,018 and $286,381 along with a 25 percent contingency cost brings the replacement cost for Alternative 2 to between **$2,079,760** and **$2,744,481** or somewhat less than estimated for a renovated facility.

Table 3: Summary of Alternative 2 Replacement Costs

Alternative 2	Estimated Cost of Warwick Pool Facility Total In-Kind Facility Replacement			
	Component	**Unit Cost Basis**	**Low Range**	**High Range**
	Building House Replacement			
	Complete Pool Building Demolition – 3,350 ft^2	\$5 - \$8/ft^2	$16,750	$26,800
	Hazmat Management/Disposal – 3,350 ft^2	\$2.38 - \$2.75/ft^2	$7,973	$9,169
	Pool Building Construction – 3,350 ft^2 (both floors)	\$160 - \$248/ft^2	$536,000	$830,000
	Upgrade Utility Service (Electrical/Water/Sewer)	est.	$25,000	$28,750
	Elevator (Include building modifications)	est.	$125,000	$150,000
	Peripheral Costs Items - Utilities, Landscaping, Retaining Wall	est.	$156,972	$180,518
	Total Building Replacement Costs:		**$867,695**	**$1,225,236**
	Pool Basin Replacement			
	Pool Demolition – 5,264 ft^2 (main) + 490 ft^2 (wading) + deck	\$6-\$9/ft^2	$34,524	$51,786
	Pool Construction (Concrete) – 5,264 ft^2 (main) + 490 ft^2 (wading) + deck	\$74.04-93.80/ft^2	$426,071	$489,982
	Pool Pumping and Filtration Equipment w/electrical	Quote	$112,000	$134,400
	Pool ADA Improvements - extra lift	est.	$6,500	$7,800
	Total Pool Basin Replacement Costs:		**$579,095**	**$683,968**
	Total In-Kind Facility Replacement (on site construction):		**$1,446,790**	**$1,909,204**
	Design Costs and General Conditions - percentage of construction costs (15%)		$217,018	$286,381
	Contingency - 25% of Design and Construction Costs		$415,952	$548,896
	Total In-Kind Replacement Project Total (on site construction):		**$2,079,760**	**$2,744,481**

Cardno also looked at potential savings that could be realized by combining the renovation/replacement alternatives. A summary of potential savings to be realized from selecting the least expensive alternative for the pool house/pool basin alternatives is presented below in *Table 4*. It is noteworthy that in only one case (High Range) does combining the least expensive pool house replacement with the relining option yield a small savings. In summary there is no compelling cost justification for pursuing the renovation option for the pool house or the pool basins.

Table 5 below summarizes costs for Alternative 3, which as described earlier, is a scaled back replacement with a one story facility to be used only for aquatics support on a seasonal basis. Key cost savings are realized by reducing the total square footage from 3,550 ft^2 to 1,850 ft^2, eliminating the need for an elevator or HVAC system. While reconfiguring the site to accommodate the entire facility at a common grade introduces the need for a higher retaining wall along the southern perimeter of the site, the other savings more than offset this cost. Although not accounted for here, it is reasonable to assume a one-story seasonally utilized facility will entail considerably lower operating and maintenance costs. The total cost of Alternative 3 is estimated at **$1,671,938** to **$2,112,121**.

Given that both of Cardno's replacement estimates fall within or below the range of estimates for renovation, there appears to be no clear cost advantage for retaining the existing pool or pool house through a complete renovation rather than replacing the entire building. Moreover, a full replacement avoids much of the uncertainty associated with attempting to retrofit older structures and systems that are in many cases beyond their expected service life and are difficult to inspect, assess and repair while intact.

Table 4: Summary of Potential Hybrid Alternative Savings

Pool House		
Alternative	**Low Range**	**High Range**
Renovate Pool House	$1,076,479	$1,237,951
Replace Pool House	$867,695	$1,225,236
Delta	***$208,784***	***$12,714***
Pool Basins		
Renovate (Reline) Pool	$592,988	$681,936
Replace Pool (Concrete)	$579,095	$683,968
Delta	***-$13,893***	***$2,031***
Potential Savings From Selecting Less Costly Alternatives		
Overall Range	**$194,891**	**$14,746**

Table 5: Summary of Alternative 3 - One-Story Replacement Costs

Alternative 3	**Estimated Cost of Warwick Pool Facility Alternate Facility Replacement - One Story Pool House - Gunite Pool**			
	Complete Pool Building Demolition – 3,550 ft^2 (both floors)	$5 - $8/$ft^2$	$16,750	$26,800
	Hazmat Management/Disposal – 3,350 ft^2 (both floors)	$2.38 - $2.75/$ft^2$	$7,973	$9,169
	Pool Building Construction – 1,850 ft^2 (single floor - same footprint)	$160 - $248/$ft^2$	$296,000	$458,800
	Upgrade Utility Service (Electrical/Water/Sewer)	est.	$25,000	$28,750
	Peripheral Costs Items - Utilities, Landscaping, Retaining Wall	est.	$238,269	$261,815
	Total Building Replacement Costs:		**$583,992**	**$785,334**
	Pool Basin Replacement - Gunite Pool			
	Pool Demolition – 5,264 ft^2 (main) + 490 ft^2 (wading) + deck	$6-$9/ft^2	$34,524	$51,786
	Pool Construction (Concrete) – 5,264 ft^2 (main) + 490 ft^2 (wading) + deck	$74.04-93.80/$ft^2$	$426,071	$489,982
	Pool Pumping and Filtration Equipment w/electrical	Quote	$112,000	$134,400
	Pool ADA Improvements - extra lift	est.	$6,500	$7,800
	Total Pool Basin Replacement Costs:		**$579,095**	**$683,968**
	Total One-Story Facility Replacement (on site construction):		**$1,163,087**	**$1,469,302**
	Design Costs and General Conditions - percentage of construction costs (15%)		$174,463	$220,395
	Contingency - 25% of Design and Construction Costs		$334,388	$422,424
	Total One Story Replacement Project Total (on site construction):		**$1,671,938**	**$2,112,121**

A fully-renovated facility will likely continue to suffer from deficiencies inherent in the aging of the original materials and its function and suitability would be limited by the basic physical basic constraints of the existing design. New construction not only provides the opportunity to re-design and construct an improved, purpose-built floor plan using modern materials and methods, but also leaves room to address underlying structural shortcomings evident in faults identified in this report.

It is noteworthy that significant savings could be realized by pursuing the hybrid approach, which derives savings from constructing an entirely new pool house at a lower cost but then renovating the existing pool basins by relining them using a Myrtha-type system. However, it's also important to note that although taking this approach yields a fully functional facility at a lower cost, the resulting pool would be somewhat reduced in size due to the encroachment of the liner system within the existing structures. It is also possible that the refitting of a completely new circulation system including all pipes and other systems beneath the existing pool floor could encounter issues that might increase overall costs or perhaps compromise the long term durability of the pool structure. Consequently, we believe the hybrid approach is not entirely without risk. A more detailed engineering design study would be required to fully evaluate the suitability and cost-effectiveness of renovating the existing pool basins.

Table 6 presents a breakdown of the pool house renovation costs on a per-floor basis based on the architectural and structural observations detailed in Sections 4 and 5. This comparison provides a basis for evaluating the impact of selecting a single or two floor design for renovation or replacement of the pool house only. Basic replacement costs are estimated based on an average of the empirically-derived per-foot basis presented in Table 3 at $205 per square foot. In the interest of simplicity, no design or contingency costs are included in this comparison since these costs are proportional to overall costs.

Table 6: Summary of Per Floor Cost Options

Per Floor Renovation Cost Breakdown (Architectural			
Element	**1st Floor**	**2nd Floor**	**Totals**
Architectural Components			
Slab on Grade	$10,550	$0	$10,550
Exterior Wall Systems	$6,899	$13,799	$20,698
Replace Windows	$12,117	$24,231	$36,347
Replace Doors	$11,658	$5,834	$17,493
Replace Roof	$19,625	$19,625	$39,250
Interior Partitions	$8,208	$2,052	$10,260
Specialties	$21,325	$10,662	$31,987
Wall Finishes	$21,850	$21,850	$43,700
Floor Finishes	$15,800	$15,800	$31,600
Ceiling Finishes	$7,206	$4,804	$12,010
	$135,238	**$118,657**	**$253,895**
Mechanical Components			
Upgrade Water/Sewer	$20,000	$20,000	$40,000
HVAC	$6,415	$12,830	$19,246
Plumbing	$23,110	$11,555	$34,666
	$49,526	**$44,386**	**$93,911**
Electrical Components			
Electrical Components	$8,494	$8,494	$16,988
Upgrade Electrical Service	$5,000	$0	$5,000
	$13,494	**$8,494**	**$21,988**
Elevator			
	$0	**$148,640**	
Building Renovation Totals - Without Elevator	**$198,257**	**$171,537**	**$369,794**
Percentage of Total - Without Elevator	**53.61%**	**46.39%**	**100.00%**

Excepting the inclusion of an elevator, the comparison confirms only a small cost difference between floors. The first floor renovation is slightly more expensive than the second mainly due to the inclusion of a new slab on grade and addressing several other architectural details. However, many items such as HVAC and doors/windows counterbalance most between-floor costs, diminishing minor differences for renovating either floor. It is expected that constructing a new one-level building on the same footprint would likely save more than half the overall costs over a two-level design. However, adding an elevator entails a substantial cost (nearly $150,000) in the event a two-level design is selected regardless of whether renovation or replacement is considered. Most peripheral costs remain essentially unchanged for the respective options and therefore the elevator imposes the primary cost differential between the one and two-floor options. Even considering items such as the retaining wall or drainage improvements doesn't substantially change the projected costs inasmuch as the driveway grade needs to be corrected for any design alternative. It is, however, worth noting that there is a potential for a single level facility to require a deeper cut into the adjacent embankment, thereby requiring a higher retaining wall. However, the costs that are already included for a wall will in either case cover most of the difference and is therefore not significant. Likewise, the foundation drainage issues also need to be addressed regardless of the building configuration. Without framing an actual design, it is difficult to elaborate further on the cost differential for specific design elements at the scoping level. For nearly all other items, including site work, hazardous materials management, utilities, etc. there are not likely significant differences between the one or two level designs because so many of the key issues must be confronted in either case. In nearly all likely designs, pool renovation or replacement costs remain the same whichever choices are made on the building design.

8.5 Recommendation

Cardno recommends fully replacing the Warwick Pool facility including the pool house and pool – with either a one or two-story building as outlined in Alternatives 2 and 3. Aside from the lack of any compelling cost or functional benefit derived from renovating obsolete structures, we believe pursuing the greater flexibility to tailor a newly designed facility to meet community needs and reduce risks associated with retrofitting obsolete, aging structures will produce a more favourable and predictable outcome for the City. Whether a single or two-level facility design is selected for the facility will require some further assessment on the part of the City to determine its needs and priorities.

9 References

Camp Desser and McKee, May 2001, City of Alexandria Warwick Pool Renovations, Alexandria, Virginia, Prelimnary Design Report

City of Alexandria – Department of Recreation, Parks and Cultural Activities, May 21, 2014 – Memorandum to James B. Spengler, Director, RCPA – Facility Assessment for Warwick Pool

City of Alexandria – Department of Recreation, Parks and Cultural Activities, May 24, 2014 – Memorandum to James B. Spengler, Director, RCPA – Facility Assessment for Warwick Pool

City of Alexandria, 2015, Parcel Viewer

City of Alexandria – Department of General Services, May 21, 2014 Assessment Report for Warwick Pool Based on Assessment of May 6, 2014.

Kimley-Horn, 2014, Warwick Pool Condition Assessment – Otherwise untitled report attached to City of Alexandria – RCPA Memorandum of May, 24, 2014.

R.S. Means, 2014, R.S. Means Cost Data, The Gordian Group, Inc.

Final Facility Assessment Report

APPENDIX

A

FACILITY PHOTOGRAPHS

Cardno
Shaping the Future

Client:	City of Alexandria	Site Location:	Warwick Pool
Site Name:	Warwick Pool	Project Number:	COA320

Photo 1

Date:
04/08/2015

Description: Warwick Pool- Pool house as viewed from the pool deck looking west. Lower wing shown in the left foreground houses pool water filtration/treatment system; upper floor houses community room; and lower level houses pool bathhouse and office.

Photo 2

Date:
04/08/2015

Description:
Warwick Pool – Pool House upper deck showing main pool house entrance.

Client:	City of Alexandria	Site Location:	Warwick Pool
Site Name:	Warwick Pool	Project Number:	COA320

APPENDIX

B

GEOTECHICAL ASSESSMENT

Geotechnical Investigation

1.1 Subsurface Exploration

As a part of Cardno's site evaluation, subsurface conditions were explored at the project site utilizing Standard Penetration Test (*SPT*) auger borings. The approximate locations of borings advanced at the site are indicated in *Figure 2 – Boring Location Plan*. Additional details explaining the exploration methods utilized by Cardno are provided in the following paragraphs. Boring logs are present in *Appendix B*.

Seven soil test borings (B-1 to B-4 and P-1 to P-3) were advanced for this project. After coring through the existing concrete slab, the borings were advanced by **Burgess & Niple** of Chantilly, Virginia utilizing a track-mounted CME 55 rig with 3.25-inch inner-diameter hollow stem augers. The borings were advanced to maximum depths of 25 feet below existing grade. SPT testing was conducted utilizing an automatic hammer at closely-spaced intervals in the upper 10 feet and at 5 foot intervals thereafter. The slab cores were backfilled with a non-shrink grout and excess spoils were hauled off-site. Please see the attached Appendix for more details concerning our subsurface exploration.

2.0 Subsurface Conditions

The soil test borings advanced at the project site have encountered three (3) strata within their termination depths, as illustrated in *Figure 3 – Subsurface Profile* as described in the following paragraphs:

2.1 Stratum A (Uncontrolled Fill)

Uncontrolled fill was encountered at test borings B-1 through B-4 beneath a surficial layer of approximately 4 to 5 inches of concrete and 9 to 10 inches of stone base, Stratum A was sampled as a mixture of clay, silt and sand with some gravel and concrete fragments. SPT resistances in the Stratum A Fill soils ranged from two to nine blows per foot (*bpf*). Based on our observation of the soil samples retrieved from our exploration, the Stratum A Fill soils should be considered uncontrolled in nature.

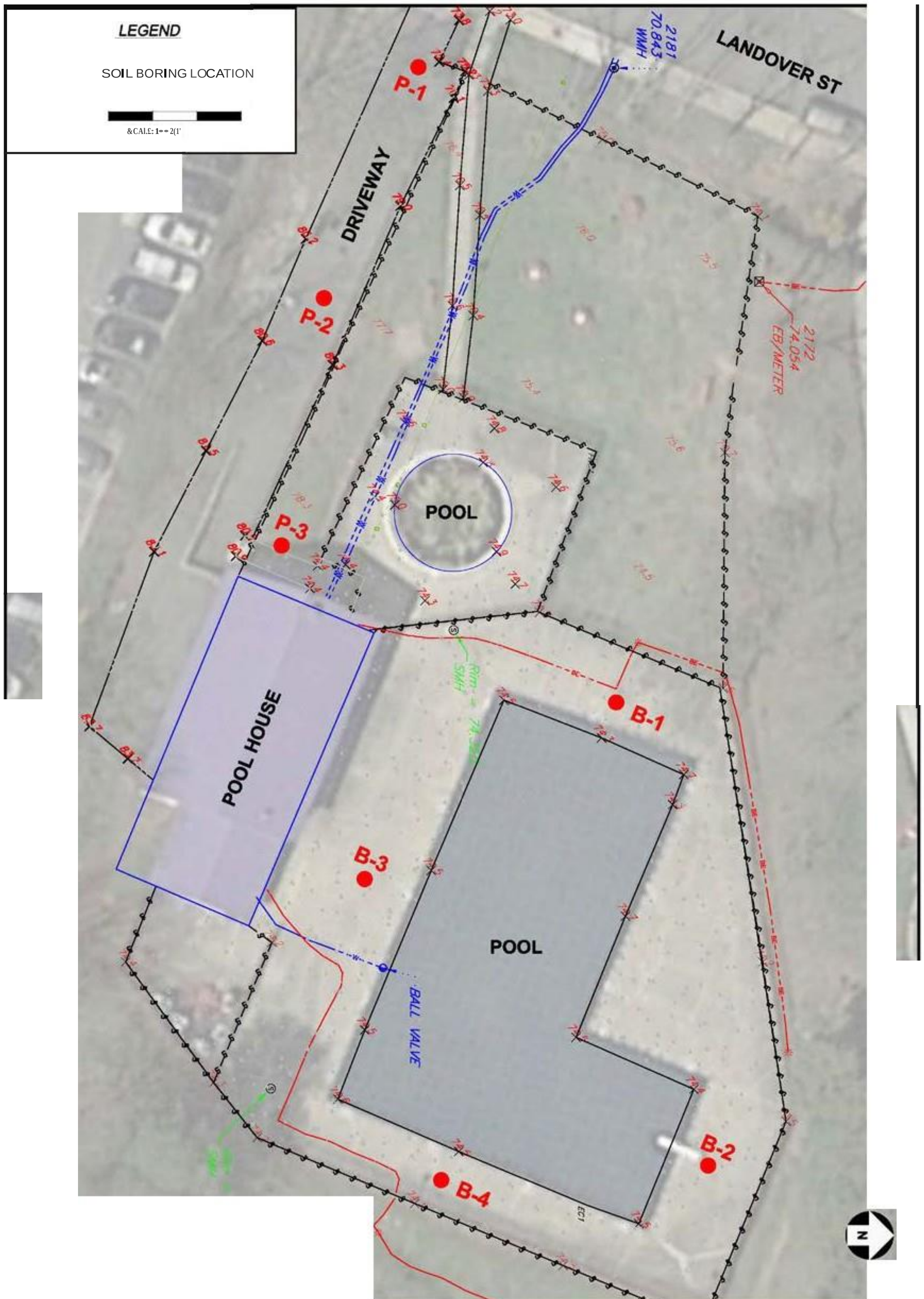
Materials were visually classified as fill based on any or all of the following observations; the apparent disturbance soil samples; the presence of deleterious matter such as aggregate, brick or asphalt fragments. It appears that the near-surface materials at the project site may have resulted from previous grading activities, however, no information concerning the previous topography of the subject site or previous site plans were provided at the time of this report. Due to the lack of documentation regarding the existing fill placement, the Stratum A fill should be considered to be uncontrolled in nature.

2.2 Stratum B (Potomac Clay)

Stratum B was encountered and sampled in each of the borings at a depth of about six feet in the pool deck area (approximate elevation +68 feet) and immediately below the asphalt entrance road and was classified as medium stiff to very stiff brown and gray silty clay (CL and CH). SPT N values generally ranged from five to 18 blows per foot (*bpf*). Stratum B appeared to vary between approximately two and seven feet in thickness.

2.3 Stratum C (Potomac Sand)

Stratum C was encountered beneath the existing Stratum A fill soils at test borings B-1 to B-4 and P-3 and beneath the existing pavement section at boring P-2. Stratum C was sampled as medium dense to dense brown and gray clayey sand (*SC*). Looser portions with SPT N values ranging from six to nine were encountered at boring P-2 to a depth of five feet below ground surface (*bgs*).



Warwick Pool Facility
3301 Landover Street
Alexandria, Vi inia

Figure 2

Site Map showing Borehole Locations

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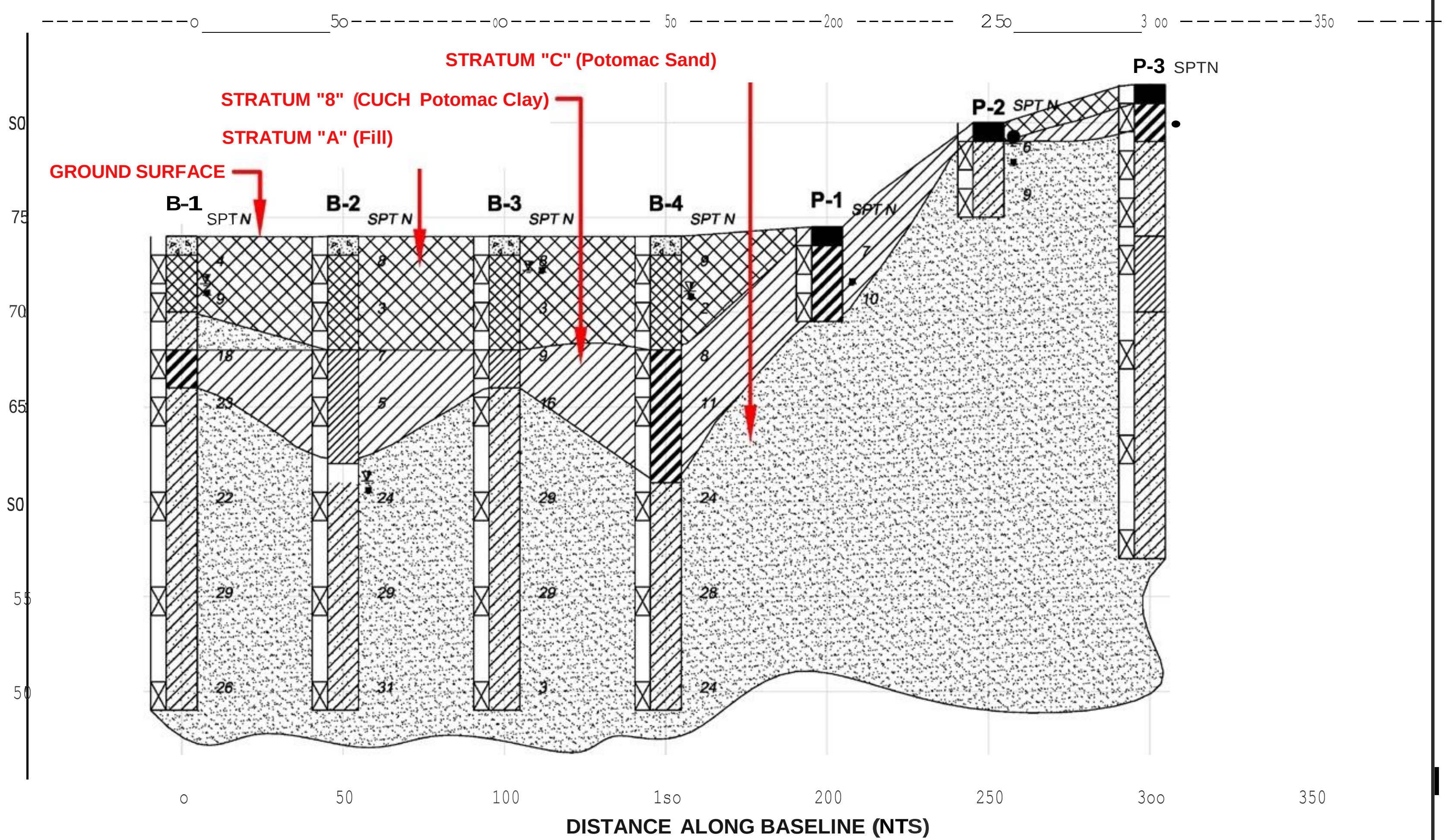

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SUBSURFACE PROFILE

3

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2.4 Groundwater Conditions

Groundwater was encountered at test borings B-1, B-3 and B-4 at depths ranging from approximately 1.8 to 2.9 feet and at test boring B-2 at a depth of 12.9 feet below existing grade. Groundwater was also encountered at boring P-2 at a depth of approximately 1.1 feet below existing grade. We attribute the relatively shallow groundwater readings at B-1, B-3, B-4 and P-2 to heavy rain experienced at the project site on the night of July 7, 2015.

Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times. These test boring records represent our interpretation of the subsurface conditions based on visual examination of field samples by a geotechnical engineer and laboratory tests of the field samples. The lines designating the interfaces between various strata on the test boring records represent the approximate interface locations. However, the actual transitions between strata may be gradual.

3.0 Laboratory Testing

Laboratory testing was conducted on selected split-spoon samples obtained during our field activities, including full sieve analysis, natural moisture content, and Atterberg limits.

4.0 Geotechnical and Construction Recommendations

The recommendations provided in this report are based on the previously-discussed project information section of this report; our observations at the time of our site reconnaissance, interpretation of the field data obtained during our subsurface explorations and our experience with similar subsurface conditions.

Based on our understanding of the project information, and the results of our site exploration, development of the subject site appears to be generally feasible from a geotechnical standpoint, subject to the recommendations contained herein.

4.1 Site Preparation

Prior to foundation construction and placement of structural fill, topsoil, vegetation, debris, and surface soils containing organic material should be removed from the construction area and either wasted from the site or used as topsoil in areas to be landscaped. Voids created due to stump removal should be carefully backfilled with structural fill in areas where planned foundations and pavements are at or near existing ground surface. Existing structures and/or utilities with associated backfill should be fully removed from the proposed construction areas and replaced with approved structural fill placed in accordance with the recommendations provided in this report. Utilities may be abandoned in place with flowable fill or lean concrete on a case-by-case basis depending upon their proximity to proposed pavement subgrades.

We recommend that backfilling operations for utilities removed from the site, as well as unsuitable soils encountered, be carried out under the observation of the geotechnical engineer or their designated representative.

During stripping and rough grading, positive surface drainage should be maintained to prevent the accumulation of water. If the exposed subgrade becomes excessively wet or frozen, or if conditions are encountered different from those described previously in this report, the geotechnical engineer should be contacted.

We recommend that proposed subgrade areas be proofrolled with a loaded, 10-wheel tandem-axle dump truck in areas scheduled to receive structural fill. Proofrolling should be conducted to detect unsuitable soil conditions, and should be performed after a suitable period of dry weather to avoid degrading an otherwise acceptable subgrade. Proofrolling operations should be observed by the geotechnical engineer or their designated representative to evaluate the support characteristics of the exposed subgrade. No new structural fill should be placed until the subgrade has been approved by the geotechnical engineer or their designated representative.

The existing uncontrolled fill soils of Stratum A contain elevated amounts of fines (silts and clays). As a result, the existing subgrades may be unsuitable for structural support (unsuitably wet, soft or yielding) at the time of construction. If at the time of construction the subgrade is found to be excessively wet, soft or yielding, it may be possible to stabilize the subgrade soils by discing, aerating and re-compacting. If it is not possible to improve the subgrade soils in this manner, the subgrade soils may be dried back to within the acceptable range of moisture contents using quicklime or a suitable lime by-product, treating the soils in-place using cement, or removal of the unsuitable soils and replacement with crushed stone or suitable fill materials determined to be appropriate by the geotechnical engineer.

The preferred method for stabilizing the subgrade and subgrade soils should be determined in the field at the time of construction based upon the actual field conditions in conjunction with the specific soil type encountered at the locations requiring stabilization, the size of the areas requiring stabilization, and the construction schedule. We recommend that contingency funds be allotted for either undercutting/replacement of unsuitable subgrade materials or for chemical stabilization of existing subgrades.

4.2 Excavation Conditions

The borings advanced for the proposed development to date have encountered uncontrolled fill materials (Stratum A) soils, highly plastic clays (Stratum B) and silty and clayey sand (Stratum C). The soils encountered to date should be considered excavatable with conventional excavation equipment.

4.3 Site Dewatering

Groundwater was encountered at test borings B-1, B-3 and B-4 at depths ranging from 1.8 to 2.9 feet and at test boring B-2 at a depth of 12.9 feet below existing grade. We attribute the relatively shallow groundwater readings at B-1, B-3 and B-4 to heavy rain experienced at the project site on the night of July 7, 2015. We do not anticipate that extensive site dewatering will be required. However, the potential for encountering perched groundwater levels, particularly within the Stratum B clayey soils, should be anticipated. In most cases, depending on seasonal conditions, seepage into construction excavations should be handled by conventional dewatering methods such as by pumping from sumps, and the use of interceptor trenches. Groundwater levels are subject to seasonal, climatic and other variations and may be different at other times and locations than those stated in this report.

4.4 Temporary Excavation Support

Details concerning the proposed construction on-site have not been provided to us at the time of this report. However, if the existing two-story pool house is to be demolished and replaced by a new structure, a temporary excavation support system must be utilized to laterally restrain the sides of the excavation and limit the movement of adjacent hillside. Our experience with similar projects indicates that a temporary excavation support system consisting of soldier piles and timber lagging is the most economical system for the conditions at this site. Depending upon the depth of the excavation and design requirements, tieback installation may be required. If tieback installation is not practical due to the presence of obstructions, internal bracing may also be utilized at the discretion of the designer.

We recommend that a specialty geotechnical contractor be engaged to design a temporary excavation support system specific to the proposed construction. The design of the temporary excavation support system and the preparation of drawings adequate to illustrate the intent of the proposed design should be conducted by a Professional Engineer registered in the Commonwealth of Virginia qualified in the design of temporary excavation support systems.

4.5 Below-Grade Construction

If the proposed site improvements necessitate below-grade construction, soil pressures acting on subgrade walls must be considered for design purposes. The magnitude of the lateral earth pressures against subgrade walls is dependent on the method of backfill placement, the type of backfill soil, drainage provisions and whether or not the wall is permitted to yield during and/or after placement of the backfill. When a wall is held rigidly against horizontal movement (such as a basement wall that is braced by the floors, structural framing and the other walls), the lateral earth pressure against the wall is greater than the "active" lateral earth pressure that is typically used in the design of free-standing retaining walls. Therefore, basement walls must be designed for higher, "at- rest" lateral earth pressures (using an at-rest lateral earth pressure coefficient, K_o), while free-standing retaining walls can be designed for active lateral earth pressures (using an active lateral earth pressure coefficient, K_a). Any surcharge loads imposed within a 45 degree slope of the base of the walls should be considered in the below grade wall or retaining wall designs. These added loads should be multiplied by the at-rest-earth pressure coefficient and added to the final load calculations.

Recommended coefficients of active, at-rest and passive earth pressures, as well as recommended moist unit weights and angles of internal friction for Strata A through C, are provided as indicated in the table below.

Recommended Soil Design Parameters

Soil Property	Stratum A (Uncontrolled Fill)	Stratum B (Potomac Clay)	Stratum C (Potomac Sand)
Moist Unit Weight, γ (lb/ft^3)	105	125	120
Angle of Internal Friction, φ (degrees)	25	0 (undrained) 30 (drained)	30
Cohesion, c (pounds per square foot)	0	3,000 (undrained) 0 (drained)	100
Active Earth Pressure Coefficient, K_a	0.40	0.33	0.33
At-Rest Earth Pressure Coefficient, K_o	0.60	0.50	0.50
Passive Earth Pressure Coefficient, K_p	2.5	3.0	3.0

Note: use c>0 and phi=0 for undrained analysis. For drained analysis, use c=0 and phi>0. Values for Stratum B clays are for undisturbed soils only.

If the below-grade walls are not designed to resist hydrostatic pressure, drainage should be provided against subgrade walls to prevent hydrostatic pressure from building up behind the walls. This can be accomplished by utilizing a commercially-available drainage board. These materials should be covered with a filter fabric having an Apparent Opening Size (*AOS*) consistent with the size of the soil to be retained. The wall drains should connect with a foundation drain situated around the perimeter of the pool house and tied to a sump pump system. A 6-inch perforated PVC pipe is recommended for use as a foundation drain. The foundation drain should be encapsulated by gravel and wrapped in a suitable non-woven geotextile.

Subgrade walls and structures should be waterproofed to limit seepage and retard the possible migration of moisture from the soil through the walls. We anticipate that waterproofing of subgrade walls can be accomplished utilizing a variety of waterproofing products, including PVC membranes, composite bentonite/polymer alloy membranes such as Cetco Voltex or adhesive-backed HDPE membranes, such as Preprufe.

4.6 Structural Fill

Re-Use of On-Site Soils

The existing fill materials of Stratum A and silty/clayey sands of Stratum C both contain locally elevated levels of fines (silt and clay) and should be considered to be moisture-sensitive in

nature. The feasibility of re-use of Stratum A and C soils as structural fill on-site beneath foundations, pavement and slab subgrades, and in fill embankments is strongly dependent upon weather conditions and the ability of the contractor to prevent the deterioration of existing soils. It should be anticipated that the Strata A and C soils may require moisture control measures prior to re-use as structural fill.

The clay soils of Stratum B are not expected to be suitable for re-use as compacted fill in structural areas, as the plasticity of these materials is excessive and are prone to excessive shrink/swell behavior.

The on-site soils are not suitable for backfill behind below-grade walls.

On-site structural fill materials should consist of soil exhibiting the following characteristics:

> Liquid Limit (LL) less than 40
> Plasticity Index (PI) less than 15
> Maximum particle size not exceeding 3 inches in any one direction
> Free of deleterious, organic and hazardous materials

Imported Structural Fill

Imported structural fill materials should consist of soil exhibiting the following characteristics:

> USCS Classification GP, GP-GM, GM, SP, SP-SM, SM
> Liquid Limit (LL) less than 40
> Plasticity Index (PI) less than 10
> Maximum particle size not exceeding 3 inches
> Percent Passing Washed No. 200 Sieve of less than 10 percent
> Free of deleterious, organic and hazardous materials

Recycled concrete materials may also be utilized for imported structural fill, provided that the gradation of the materials are compliant with the recommendations provided in this report, and that these materials are free of deleterious or hazardous materials.

It should be noted that the tolerances with respect to plasticity, gradation and fines content for imported structural fills are more stringent than the existing on-site soils being recommended for re-use. It is anticipated that the importing of structural fill to the project site may be necessary during winter or spring months. As such, the structural fill brought to the site should be expected to possess properties that are conducive to being workable and compactible during these time periods.

4.7 Structural Fill Placement

We recommend that representative samples of on-site soils, imported soils or recycled concrete materials be collected and tested no earlier than one week before commencement of structural fill placement operations. If significant variations in gradation and or plasticity of on-site soils are expected, representative samples of each soil type should be obtained. These tests are needed for quality control during compaction and also to determine if the structural fill material is compliant with the recommendations provided in this report. Proposed structural fill samples should be visually classified and tested in the laboratory to determine, at a minimum, the following properties:

> Soil Gradation (ASTM D6913);
> Natural Moisture Content (ASTM 2216);
> Optimum Moisture Content and Maximum Dry Density per the Modified Proctor method (ASTM D1557);

> Soil Plasticity (ASTM D4318);

> If visual classification of the soils by the Geotechnical Engineer or their designated representative indicates the potential for organic materials, Organic Content testing (ASTM D2974) should also be performed.

Providers of recycled concrete materials should provide documentation indicating that the proposed structural fill materials are free of hazardous or deleterious materials in accordance with local, state and federal regulations.

We recommend that areas where structural fill will be placed be scarified and proofrolled prior to placement as previously stated in this report. Once the subgrade has been properly prepared and accepted by the Geotechnical Engineer of their designated representative, structural fill may be placed to achieve planned subgrade elevations.

Structural fill materials be compacted using the criteria listed in the table below.

Recommended Structural Fill Compaction Criteria

Location	Percent Compaction (Modified Proctor ASTM D1557)
Fills below foundations, floor slabs, and slopes	95
Fills and utility backfill within top 24 inches of pavement subgrade	95
Fills and utility backfill below top 24 inches of pavement subgrade	92

Additional structural fill placement considerations are provided below:

> Structural fill should not be placed on frozen or saturated subgrades.

> Structural fill should be placed within 3 percent of the optimum moisture content as determined by Modified Proctor (ASTM D1557).

> Structural fill should be placed in continuous horizontal layers no greater than 8 inches in thickness. In confined areas such as utility trenches where only small and light compaction equipment can be used, lifts of 3 to 4 inches may be required to achieve the specified degree of compaction.

> Benched fill surfaces should be notched by cutting not less than 4 feet horizontally into the slope every 16 inches. This sequence of construction will result in stronger mechanical bonding between soil layers and prevent the formation of weakened shear zones oriented parallel to the final grade of the slope.

> Temporary fill slopes should be regularly evaluated for indications of movements during the construction. Soil slopes should be covered for protection from rain and surface water run-off should be diverted away from slopes. For erosion protection, grass or other vegetation should be established on permanent soil slopes as soon as practical.

> Structural fills should extend horizontally outside of planned paved and building areas at least 5 and 10 feet, respectively, before sloping.

> Cut and fill slopes in soil should be constructed at a ratio of 3 (horizontal) to 1 (vertical) or flatter for general stability and ease of maintenance. The feasibility of steeper slopes should be verified through slope stability analyses.

Prepared structural fills that are found to be stable and compacted in compliance with the recommendations provided herein at the time of construction may degrade due to repeated construction traffic loading and inclement weather conditions. We recommend that the locations of haul roads for construction equipment be designated prior to construction. Haul road subgrades can typically be improved through the placement of additional stone, geogrid plus additional stone, or the introduction of Portland cement into the existing subgrade to form a stabilized soil-cement base. Additional information can be provided concerning the stabilization of existing soils for haul road subgrades if requested.

4.8 Grade Slabs

The geotechnical engineer or their authorized representative should review subgrade conditions prior to concrete floor slab construction. The floor slab subgrade should be proofrolled with a loaded dump truck or other methods approved by the geotechnical engineer to detect any excessively yielding subgrade conditions. Unsuitably loose, soft, wet, highly plastic or otherwise deleterious materials encountered at the floor slab subgrade should be removed and replaced with a minimum of 12 inches of structural fill in accordance with the recommendations provided in this report.

The thickness of the concrete floor slab will depend upon the magnitude of the expected loading and should be designed by the structural engineer. A subgrade modulus (*k*) of 120 pounds per square inch per inch (*psi/inch*) is recommended for design purposes for the floor slab subgrade soils. We recommend that the concrete floor slab be supported on suitable soil founded upon a minimum 4-inch thick layer of No. 57 stone, graded aggregate base (*GAB*) or other acceptable granular stone to distribute the concentrated loads, enhance drainage, and reduce degradation of the prepared subgrade during construction.

A polyethylene vapor retardant barrier may be used to prevent migration of moisture through the slab. However, proper concrete mix designs, placement methods, and curing practices must be used to reduce the potential for concrete shrinkage problems that are sometimes associated with the use of a vapor retardant barrier. The reader is referred to American Concrete Institute (*ACI*) guidelines for proper installation of a vapor retardant barrier. The performance of concrete floor slabs is also affected by the concrete mix that is used. A relatively high water-cement ratio of the concrete can cause aesthetic disruptions, such as unsightly slab “curling” and shrinkage cracking. Also, an additional waiting period may be required prior to installing moisture-sensitive floor covering because of the moisture loss from the concrete floor slab.

We recommend that the floor slabs be jointed around columns and along footing-supported walls so that the slab and foundations can settle differentially without damage. Joints containing smooth dowels or keys may be used in the slab to permit rotational movement between parts of the slab without sharp vertical displacements or cracking. Control joints should also be provided to control shrinkage cracking of the concrete floor system.

4.9 Foundations

Spread Footings

The existing Stratum A fill soils are unsuitable for direct foundation support, as these materials appear to have been placed in a loose, uncontrolled manner. In addition, looser/softer areas of the existing Stratum B soils underlying the existing Stratum A fill are also unsuitable for foundation support.

Spread footing foundations will need to be undercut to bear upon competent Stratum B or C soils or newly-placed structural fill placed in accordance with the recommendations provided in this report. Spread footing foundations should be designed for a maximum allowable bearing pressure of 2,500 pounds per square foot (*psf*). The following table provides approximate depths to suitable Stratum B or C foundation bearing materials.

Total and differential settlements for individual column and wall footings were computed and were found to be less than 1 inch and ½ inch, respectively. Settlements should be expected to occur during or shortly after construction.

Approximate Depths to Suitable Foundation Bearing Materials

Boring ID	Approximate Depth to Suitable Foundation Bearing Materials (feet)	Approximate Elevation of Suitable Foundation Bearing Materials (feet, msl)
B-1	5.0	+69.0
B-2	6.0	+68.0
B-3	6.0	+68.0
B-4	6.0	+68.0
P-3	3.0	+79.0

Attention is directed to the locally highly plastic soils present in Stratum B. These materials appear to be acceptably stiff and generally suitable for foundation support. However, the highly plastic soils of Stratum B are prone to shrink-swell behavior when exposed to changes in soil moisture conditions. Therefore, the footing bearing surfaces should be extended through the zone of expected soil moisture variation to a depth of 5 feet below existing grades.

Wall and column footings should be a minimum of 24 and 30 inches wide, respectively. The minimum footing sizes should be used regardless of whether or not the foundation loads and allowable bearing pressures dictate a smaller size. These minimum footing sizes tend to provide adequate load bearing area to develop overall bearing capacity and account for minor variations in the bearing materials.

Uplift forces on the footings can be resisted by the weight of the footings and the soil material that is placed over the footings. It is recommended that the soil weight considered to resist uplift loads be limited to that immediately above and within the perimeter of the footings. A total soil unit weight of 120 pounds per cubic foot (*pcf*) can be used for the backfill material placed above the footings, provided it is placed as recommended in this report. It is also recommended that a factor of safety of at least 1.2 be used for calculating uplift resistance from the footings (provided only the weight of the footing and the soil immediately above it are used to resist uplift forces).

Lateral forces on shallow footings can be resisted by the passive lateral earth pressure against the side of the footing and by friction between the subgrade soil and the base of the footing. An allowable coefficient of friction (between the base of the footing and the underlying soil) of 0.35 (based on a factor of safety of 1.5) can be used in conjunction with the minimum downward load on the base of the footing.

Foundation excavations must be examined and tested by the geotechnical engineer or their authorized representative to ensure that the footing foundations will bear on suitable materials. The foundation bearing areas should be level or suitably benched and be free of loose soil, ponded water, and debris prior to the observation. We recommend that the recommended bearing capacities for the foundations be verified in the field by visual observation and conducting dynamic cone penetration (*DCP*) tests. The geotechnical engineer or their authorized representative should document the results of DCP testing and the characteristics of the visible soil in the excavation. Any significant differences between field observations and our test boring records should be brought to the attention of the owner's representative along with appropriate recommendations.

Proper foundation construction procedures can enhance long-term foundation performance. We recommend the following procedures be used during foundation construction:

> The foundation bearing area should be level.

> Loosened soil, debris, or excess water should be removed from the excavation prior to concrete placement.

> If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete.

> Foundation concrete should not be placed on frozen or saturated subgrades.

> Foundation concrete should be placed in the excavations the same day the foundations are opened and approved. If this is not practical, or if bearing materials must remain open for an extended time, the exposed support materials should be protected from freezing weather, severe drying, and water accumulation by construction of a concrete "mud-mat."

> Care should be exercised during winter months to prevent freezing of subgrade soils and backfill prior to or after the placement of concrete.

> Foundation excavations should be backfilled with foundation concrete without the use of forms. Where forms are used, the forms must be removed and the subsequent void replaced with properly compacted structural fill.

Helical Piles

We understand that a stainless steel pool liner structure is being considered for the site in lieu of removal and replacing of the existing concrete pool. It is our further understanding that the steel liner is supported by a series of helical piers. Based on the subsurface conditions encountered and the assumption that the spread footing and helical pile installations will be inspected on a full-time basis by a geotechnical engineer or their designated representative, the proposed pool house can generally be supported on shallow spread footings supported by helical piles bearing in the competent soils of Stratum C, subject to the recommendations provided in this geotechnical report.

To provide adequate support for the proposed pool liner, we anticipate that helical piles extending on the order of 10 to 15 feet into the Stratum C clayey sand layer could achieve a design capacity of 25 kips per pile. As a preliminary design, the helical piles should have 14-inch helical flight plates, a minimum 2 7/8 inch diameter pipe with 0.25-inch wall thickness, and 10 foot bolted extensions with grouted shafts. The helical pile installer should use their system to develop the final design details.

Load testing of the test piles is recommended to verify that the contractor's construction methods and installation equipment can produce a foundation which will perform satisfactorily. We recommend that minimum of three piles be tested. The geotechnical engineer should be retained to select the test piles to be load tested, witness the load test, analyze and report the load test results and develop recommendations for production foundation depths and installation procedures. The load test should be performed in general accordance with ASTM D 1143. The pile should be loaded to failure or at least 2.5 times the design capacity, whichever occurs first.

3.6.6 Pavements

Information concerning proposed vehicle types and volumes were not provided to us at the time of this report. However, based on our experience with similar sites and similar subsurface conditions, we recommend three pavement designs be considered for this project. Light-duty pavement should be utilized in areas designated for vehicular parking. Heavy-duty pavement should be utilized in drive aisles and site entrances.

Reinforced concrete pavements should be utilized in loading dock and trash enclosures. The design of reinforcing for the reinforced concrete pavement is beyond our scope of services for this project. Our proposed asphalt and reinforced concrete pavement sections for the subject site are provided in the table below.

The above pavement sections are designed to accommodate post-construction traffic. Partial construction of the pavement sections is not recommended. In addition, as paving and grading are typically performed by separate contractors, a time lapse generally occurs between the end of grading operations and the commencement of paving. Disturbance, desiccation, and/or wetting of the subgrade prior to completion of paving can result in deterioration of the previously completed subgrade. A non-uniform subgrade can result in poor pavement performance and local failures relatively soon after pavements are constructed. Where applicable, we recommend the pavement subgrade be proof-rolled and the moisture content and density of the top 8 inches of subgrade be checked within two days prior to commencement of actual paving operations.

Recommended Asphalt and Reinforced Concrete Pavement Summary

Paving Material	Light-Duty Pavement	Heavy-Duty Pavement	Reinforced Concrete Pavement
Hot Mix Asphalt, Top Course (9.5 mm Superpave, PG 64-22 Binder)	2.0 inches	2.0 inches	-
Hot Mix Asphalt, Dense Binder Course (19.0 mm Superpave, PG 64-22 Binder)	2.0 inches	3.0 inches	-
Portland Cement Concrete (minimum 4,000 psi design strength)	-	-	6.0 inches
Open-Graded Subbase	6.0 inches	6.0 inches	6.0 inches
Minimum 12 inches proofrolled and/or compacted subgrade to at least 95 percent of maximum dry density as determined by Modified Proctor (ASTM D1557)			

Materials utilized for pavement construction should be tested in accordance with applicable sections of Virginia Department of Transportation (VDOT) Road and Bridge Specifications, latest edition, as well as applicable local and state requirements.

If any significant temperature changes or precipitation events occur after proof-rolling, the subgrade should be reviewed by the Geotechnical Engineer or their designated representative prior to placing the pavement. The subgrade should be in its finished form at the time of the final review.

4.10 Stormwater Management

Information regarding proposed stormwater management facilities were not provided to us at the time of this report. Field infiltration testing was not conducted at the project site to determine the suitability of existing soils for infiltration design. Based on our test results, the soil types encountered at the site, and our understanding of the geologic setting underlying the project site, the Stratum A and B soils encountered during our exploration should be considered unsuitable for infiltration for the following reasons:

> Stratum A fill was generally encountered across the site at varying depths. For stormwater management purposes, the founding of infiltration devices in fill materials is typically not permitted.

> Stratum B Potomac Clay was encountered throughout the project site and is not expected to be suitable infiltration purposes due to the low permeability and high plasticity of these soils.

> The sands of Stratum C appear to have varying amounts of clay and may be suitable for infiltration. We recommend that field infiltration testing be conducted to verify the suitability of Stratum C for design purposes.

4.11 Site Seismicity

The City of Alexandria and surrounding Washington DC metropolitan area is not as seismically active compared to states located near major tectonic plate boundaries. The probability of the project site experiencing a major earthquake is small. According to the U.S. Geological Survey Earthquake Database, which includes earthquake data from 1973 to the present, there have been two historical earthquakes with a magnitude (*Mw*) of 5.0 or higher. This includes earthquakes an Mw=5.0 event from January 31, 1986, and an Mw=5.8 event from August 23, 2011.

The August 23, 2011 earthquake (Mw = 5.8), centered approximately 82 miles southwest of the project site, resulted in a recorded peak velocity of 9.2 cm/sec (3.6 inches/sec) and a maximum acceleration 0.1045 g (10.45 percent of gravity) approximately 1.5 kilometer (1 mile) from the project site, corresponding with a Modified

Mercalli Intensity (*MMI*) value of VI. An MMI value of VI is generally indicative of strong perceived shaking and potential for light damage to existing structures.

The Virginia Uniform Statewide Building Code (*VUSBC*) is adapted from the 2012 International Building Code (IBC). In accordance with IBC, Seismic Site Class must be evaluated based on the subsurface profile within the upper 100 feet of existing ground surface. The estimated subsurface profile and soil properties were based upon available geologic mapping and our experience with similar subsurface conditions in the vicinity of the project site. Based on our review of the available data, understanding of regional geology and the test boring results, the site is classified as Site Class E. The recommended seismic design values are provided in the table below. The United States Geologic Survey (*USGS*)-NEHRP probabilistic ground motion values for the site, as obtained from the USGS Ground Motion Parameter Calculator at the following website: (http://earthquake.usgs.gov/hazards/designmaps/javacalc.php), are also provided below.

Recommended Seismic Design Values

Seismic Site Class	D
Mapped spectral acceleration for short periods (S_S)	0.118 g
Mapped spectral acceleration for one-second period (S_1)	0.051 g
Site Coefficient, F_A	1.6
Site Coefficient, F_V	2.4
Maximum Considered Earthquake spectral response for short periods (SM_S)	0.190 g
Maximum Considered Earthquake spectral response for one-second period (SM_1)	0.123 g
Design Spectral Response acceleration at short periods (SD_S)	0.126 g
Design Spectral Response acceleration at one-second period (SD_1)	0.082 g

Note: g refers to the acceleration due to the force of gravity

5.0 Existing Conditions Surveying and Construction Monitoring

Due to the proximity of the proposed construction to existing buildings and improvements, we recommend that existing condition surveying of neighboring structures and a comprehensive monitoring program be implemented. We recommend that a specialty firm(s) be engaged to provide pre- and post-construction condition surveying and construction monitoring for the project site. The firm(s) selected should have experience with similar project sites and should be directed by a qualified Professional Engineer registered in the Commonwealth of Virginia. Details concerning our recommendations are provided in the following sections.

5.1 Existing Condition Surveying

Prior to commencement of construction, we recommend that structural condition surveys should be performed to document existing baseline conditions at the adjacent properties. Special consideration should be given to evidence of existing cracks, leaks, settlement or other such deficiencies that could later be attributed to construction activities at the project site. The structural condition survey should evaluate the physical condition of the following building elements specifically for evidence of structural distress such as cracks, spalls, abnormal displacements, and so on:

> Structural systems (foundations and structural framing of walls, columns, intermediate floors and roofs)

> Building envelope systems (roof, exterior finishes, stairs and steps, exterior doors and windows)

> Interior building finishes

Construction/maintenance documents, if made available during the site inspection, should be reviewed and property representatives interviewed. If evidence of structural distress (such as cracks) is observed during the pre-construction survey, crack-monitoring devices should be installed, upon approval of the Client, to monitor long-term movement.

The results of the survey should be documented in a written report, video documentation, and color photographs.

5.2 Construction Vibration and Monitoring Plan

In addition to the previously-referenced pre- and post-construction surveying, we recommend that a comprehensive construction vibration and monitoring program be implemented to document that construction activities did not damage or detrimentally affect existing structures. We recommend that survey points be installed on temporary excavation systems, adjacent streets, and neighboring buildings to monitor the movement of the excavation and surrounding structures during construction.

A vibration monitoring program should be implemented during construction to monitor to record Peak Particle Velocity (*PPV*) levels at adjacent structures resulting from soil excavation and general construction activities. Monitoring of survey points and vibration levels should be conducted for any structure within 50 feet of the excavation. With respect to PPV level thresholds, it is commonplace to recommend that construction vibrations be limited to no more than 2.0 in/sec. Due to the historical nature of the surrounding neighborhood, more stringent limitations upon vibrations may be desirable.

6.0 Recommended Additional Services

At the time of this report, Cardno is the geotechnical engineer of record for this project. We should be retained to review the final project plans to ensure that our recommendations are appropriately incorporated into the contract documents. We also recommend that Cardno be retained to provide special inspection and materials testing and observation services during construction to ensure continuation of geotechnical interpretation and to verify that the recommendations prepared for geotechnical aspects of site development are adhered to during construction.

If an outside firm is selected to provide foundation inspection and/or construction materials testing and observation services during construction for this project, the engaged firm should prepare a letter indicating their intent to assume the responsibilities as geotechnical engineer of record. The selected firm should also provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report.

Additional soil and foundation engineering, testing, and consulting services recommended for this project are summarized below.

> **Review of Final Project Plans and Specifications:** As finalized project documents were not available at the time of this report, we recommend that Cardno be engaged to review the final project plans and specifications to ensure that our recommendations are appropriately incorporated into the project documents.

> **Special Inspections/Structural Fill Placement and Compaction**: An experienced and appropriately certified soils engineering technician should witness any required structural fill placement operations and should perform sufficient in-place density tests to verify that the required degree of compaction is achieved. The technician should also evaluate borrow materials used and determine if their existing moisture contents are suitable.

> **Foundation Excavation Examination and Testing**: The geotechnical engineer or an experienced and appropriately-qualified soils engineering technician should examine all foundation excavations. The technician should document the results of helical pile load test and installation activities. Significant differences between field observations and our test boring records should be brought to the attention of the Owner's representative along with appropriate recommendations.

7.0 Limitations of Study

7.1 Environmental Issues

Our scope of services did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, ground water, or surface water within or beyond the site studied. Any statements in the report regarding odors, staining of soils, or other unusual conditions observed have been provided strictly for the information of our client.

7.2 Differing Conditions

Recommendations for this project were developed utilizing soil information obtained from the test borings that were completed at the proposed site. These borings indicate subsurface soil and groundwater conditions at the specific locations and time at which the borings were conducted. Conditions at other locations on the site may differ from those occurring at the boring positions. If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the immediate attention of the Geotechnical Engineer so that recommendations can be reviewed and revised as required.

7.3 Changes in Plans

The conclusions and recommendations herein have been based upon the available soil information and the preliminary design details furnished by a representative of the owner of the proposed project and/or as assumed herein. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the geotechnical engineer to determine whether any changes in the foundation or earthwork recommendations are necessary.

7.4 Recommendations Versus Final Design

This report and the recommendations included within are not intended as a final design, but rather as a basis for the final design to be completed by others. It is the client’s responsibility to insure that the recommendations of the geotechnical engineer are properly integrated into the design, and that the geotechnical engineer is provided the opportunity for design input and comment after the submittal of this report, as needed.

It is strongly recommended that Cardno be retained to review the final construction documents to confirm that the proposed project design sufficiently incorporates the geotechnical recommendations. Cardno should be represented at pre-bid and/or pre-construction meetings regarding this project to offer any needed clarifications of the geotechnical information to all involved.

7.5 Construction Issues

Although general constructability issues have been considered in this report, the means, methods, techniques, sequences and operations of construction, safety precautions, and all items incidental thereto and consequences of, are the responsibility of the parties to the project other than Cardno. This office should be contacted if any guidance is needed in these matters.

7.6 Report Interpretation

Cardno is not responsible for conclusions, opinions, or recommendations developed by others on the basis of the data included herein. It is the client’s responsibility to seek any guidance and clarifications from the Geotechnical Engineer needed for proper interpretation of this report.

7.7 Standard of Care

The professional services and engineering recommendations presented in this report have been developed in accordance with generally accepted geotechnical engineering principles and practices in the geographical area of the project at the time of the report. No other warranties, either expressed or implied, are offered.

Final Facility Assessment Report

APPENDIX

C

COST ESTIMATE DETAILS

Cardno
Shaping the Future

Estimated Costs of Warwick Pool Renovations				
Source	Item	Item Costs	Low Range	High Range
	Architectural Components			
1	Slab on Grade	$10,550	$253,915	$292,002
1	Exterior Wall Systems	$20,700		
1	Replace Windows	$36,350		
1	Replace Doors	$17,505		
1	Replace Roof	$39,250		
1	Interior Partitions	$10,260		
1	Specialties	$31,990		
1	Wall Finishes	$43,700		
1	Floor Finishes	$31,600		
1	Ceiling Finishes	$12,010		
	Mechanical Components			
2	Upgrade Water/Sewer	$20,000	$73,934	$85,024
1	HVAC	$19,265		
1	Plumbing	$34,669		
	Electrical			
1	Electrical Components	$16,988	$21,988	$25,286
2	Upgrade Electrical Service	$5,000		
	Per Floor Architectural Rennovation Costs			
	ADA Compliance			
1	Site Access	$90,400	$459,670	$528,621
1	Outdoor Activities	$80,160		
1	Building Access	$140,470		
3	Elevator (Include building modifications)	$148,640		
	Structural Restoration			
2	Drainage Improvements (building foundation)	$75,000	$110,000	$126,500
2	Repair cracks in northeast corner of building foundation	$35,000		
	Peripheral Items - Rennovation			
2	Stormwater Management (grading, piping, BMPs)	$25,000	$156,972	$180,518
2	Utilities - repair/replace service	$15,000		
4	Partial Demolition w/Hazmat Management - Containment/Removal	$13,000		
3	6-ft Retaining wall (183 LF)	$81,297		
3	Perimeter and Internal 6-ft Fence Replacement 961 LF	$11,292		
2	Landscaping	$11,383		
	Pool - Rennovation			
4	Partial Demolition (Deck, Mechanical and Pool Drainage)	$10,000	$592,988	$681,936
4	Pool Deck Replacement (rennovation not advised)	$150,000		
4	Main Pool Rennovation - Myrtha Type Liner System	$235,000		
4	Wading Pool Renovation - Myrtha Liner	$62,500		
4	Electrical - service for filtration and pumps	$16,988		
4	Replace Pool Drainage and Filtration/Pumps	$118,500		
	Estimated Construction Cost of Fully Renovated Facility:		**$1,669,467**	**$1,919,887**
	Design Costs (15% of Construction):		**$250,420**	**$287,983**
	25% Contingency (Construction + Design):		**$479,972**	**$551,967**
	Total Rennovation Costs		**$2,399,858**	**$2,759,837**

Sources: 1-Based on R.S. Means Estimator - in some cases this is adjusted based on professional judgement to account for the level of complexity
2-Professional judgement based on the experience of the authors
3-Other published sources - generally poll of internet sources
4-Site specific quote provided by local or regional vendors for specific items
Pool items are from Pool Services, Myrtha Pool USA and Endless Summer Aquatics; demolition and hazardous materials from Canada Contracting