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Aquatic Facility Inspection Report

Date of Inspection: 10 October 2016

Location: East Pennsboro Middle School Natatorium

Perspective

The District was recently made aware that chlorinated waste was detected in storm water discharge emanating from the middle school. A subsequent investigation determined that both a sanitary line from the filter room and a storm water line were broken underground in close proximity to one another thus allowing mixing of the flows from the two pipes. Ultimately the local sanitary authority has taken the position that in addition to repairing the two pipes, the District must insure that all future sanitary discharge must be chlorine-free. These events prompted our engagement to inspect and report on the pool as a whole with a special focus on the waste discharge.

Pool Shell

Owing to the broken pipes and sanitary authority requirements discussed above, the District decided to empty the pool until repairs and changes to the mechanical system could be completed. Therefore, the pool was empty at the time of our inspection. This afforded us the opportunity to inspect the shell interior closely.

We found the structure and tile finish to be in very good condition. There are a few missing tiles and the grout is somewhat deteriorated but on whole it's in good shape. A number of tiles had been removed by others to facilitate drilled probes for the purpose of evaluating the subsurface condition. Presumably the subsurface report has been received by the District, we have not seen or reviewed it. Obviously the drilled holes should be patched and all missing tiles replaced before the pool is refilled.

We noted traces of dark-colored dried algae in some of the grout joints giving the appearance of missing grout. We also noted traces of dried body oil on the tile surface, primarily in the gutter area. The tile surface would benefit from a thorough cleaning with a strong detergent followed by pressure washing and/or light acid-washing as may be necessary to remove surface deposits. The stainless steel railings should be thoroughly cleaned and the lifeguard stand pedestal could use fresh paint. The existing starting platforms are dated both in terms of function and appearance. They are bolted in place which makes them permanent rather than removable and the inability to readily remove the platforms increases the likelihood of use by unauthorized bathers with the potential for serious injury. At a minimum, safety coverings should be added to prevent unauthorized and/or unsupervised use and ideally they should be replaced with single or dual post, positive-locking style, and removable platforms, but aside from this safety concern, they appear to be safe.

At the time the subject pool was designed, it was not appreciated that most contamination in the water, while invisible, is at the very surface, making an effective perimeter overflow system of key importance in the control of water-borne pathogens. While it is still in very good condition, the perimeter system on the subject pool is too small and has too few

outlets to be effective as it will easily flood with even moderate bather activity. Current codes and best design practices require static and dynamic surge storage equivalent to one gallon per square foot of water surface area. The present pool architecture and mechanical system accommodates virtually no surge storage which is why the pool gutter floods and becomes ineffective when operated as designed. The present pool/gutter architecture also presents a difficult freeboard dimension of 14" (distance between the water level and the deck level) making egress more cumbersome than necessary.

A new stainless steel integral perimeter system could take the place of all the existing gutter and gutter/filtered water supply perimeter piping as well as provide increased flow capability in the gutter channel, in-pool surge capacity and could be mounted higher to increase the water depth to 4'-0" at the shallow end, which is a better depth for competitive flip turns. Such a system, which resolves all of the pool architectural and perimeter process piping deficiencies for the remaining life of the building, would be a good investment. A review of the original structural drawings of the pool wall and deck interface must be conducted to determine if a new stainless steel system could be retrofitted.

The existing main drain grates are compliant with current Federal anti-entrapment codes, however the drain sumps and embedded piping were constructed of ferrous metal and are very badly corroded. They are well passed their useful life expectancy and could fail at any time causing serious water loss and potential erosion of the pool structure subbase. District staff reports that the embedded pipes were recently inspected by camera and that the condition of the interior of the piping that carries the water to the filter system is similar to the interior of the drain sump.


Main drain sump interior

Filtration System (located in basement mechanical space behind deep end wall)
The existing filtration system is a vacuum diatomaceous type consisting of an open, fiberglass tank that contains fourteen filter elements. It is serviced by a 7½ HP pump. The filter system has the capacity to filter all of the pool water once every eight hours. The current code requires a capacity to filter the water in six hours, making the system about 25% undersized. Staff reports filter tank leakage in one or two locations (could not be confirmed at time of inspection).

As one might imagine, an open tank located below water level could be prone to overflowing and flooding its environment. The mechanism that prevents this from happening is known to fail occasionally especially as it ages and flooding has happened once in the past two years, which was the limit of the historical memory of the two staff members accompanying us during our visit. We note the presence of three-phase, 240-volt electrical service in the filter area, making any flooding very dangerous. Much of the exposed bottom drain piping connecting the pool to the filter is the original ferrous metal which is heavily corroded. Some non-essential service valves incorporated into the metal piping have been essentially abandoned in place by staff not wanting to risk valve failure by operating them.

Addressing New Sanitary Authority Requirements
Cleaning the filter involves draining the water out after it's been isolated from the pool, and manually cleaning the dirty diatomaceous earth off of the filter elements with a garden hose. The residual slurry in the bottom of the tank is then drained by gravity into the sanitary line traveling under the filter room floor. Staff then allows pool water into the tank which is in turn drained as rinse water. Staff advises that essentially four tanks full of water are drained during the cleaning process, which we would estimate occurs every six weeks or so. We would estimate the waste water discharged during each cleaning sequence to be approximately 2,500 gallons. The chlorine in the waste water would dissipate over 7 – 10 days if it were stored before being discharged into the sanitary piping. There is adequate access and space in the filter area for appropriate storage tanks without modifying the existing piping or doorway and the waste water slurry from the filter could be pumped into storage tanks rather than drained by gravity. If the District chose to do nothing else other than the minimum required to accommodate the new sanitary authority requirements, it could add the waste water storage and slurry pump and operate as before albeit on "borrowed time" considering the condition of the main drain sumps and piping.

Maintenance Concerns (within five years)

- See main drain note below
- An operable flow meter was not observed and should be added.
- Routine gauge replacement may be required
- Filter element covers may have to be replaced.
- Replace or rebuild filter overflow protection diaphragm valves.
- Replace butterfly valves as may be required.

Conclusions & Recommendations

1. Replace the main drain sumps and piping to the filter system to avoid unplanned interruptions and potentially serious damage. New sumps and piping should be sized to accommodate a six-hour recirculation rate. Highest priority.
2. We recommend that a new regenerative media filter be installed to replace the existing filter. High priority, ancillary benefits of the new system include the following;
    a. Higher flow rate to achieve a six-hour turnover.
    b. The new system uses Pearlite as a filter media which is added utilizing an integral "shop vac" type suction hose rather than the current method of hand-mixing a slurry. Diatomaceous earth is a suspected carcinogen when its dust is inhaled. Pearlite is much safer for operating personnel to handle and it fluidizes readily making it considerably safer for discharge into the sanitary system as it is much less likely to build up in the piping.
    c. The new system is automated and will renew the filter media (Pearlite) many times before it must be changed, which saves waste water discharge as well as labor.
    d. Changing the media is fast and easy and involves about one third of the waste water discharge.
    e. It would have a companion component variable frequency drive motor control to fine-tune pump power usage and avoid wasting energy.
3. We recommend the addition of an upgraded water chemistry controller that can monitor other operational parameters such as water temperature, filter flow and filter pressures as well as chlorine residual, oxidation reduction potential (ORP) and pH. Such units can be adapted by various means for remote monitoring such as through the school's local area network so that facilities personnel can conduct many of their routine checks from a desktop PC., tablet, smart phone, etc.
4. In order to control the chloramines that result from chlorine use, which are particularly harmful to bathers with repertory difficulties and often cause deterioration of building components, a new, medium pressure, ultra violet light disinfection system should be installed to help control chloramine accumulation in the water thereby making the pool environment safe and comfortable for staff and bathers and friendly to building components. Additionally, a UV system will destroy any chloramine-resistant pathogens that pass through the filter system.
5. Even with the UV system, chloramines will evolve to into a non-soluble state quickly during periods heavy use (see attached white paper). A source-capture chloramine removal system, possibly built into a new perimeter system, should be added as an auxiliary HVAC component.
6. A new automatic water level control system should be installed so that make-up water is automatically added to replace loss due to evaporation and splash-out.
7. The existing gravity drain to waste, currently abandoned in place due to deteriorated piping, should be replaced with a small drain-down pump to facilitate emptying the pool for periodic maintenance.
8. The existing grab rails should be replaced or thoroughly cleaned as part of any major renovation.
9. A built-in conduit and connection infrastructure for the timing system could be retrofit to avoid wires stretched out on the deck during competitive events.
10. Federal accessibility regulations require a permanent accessibility component, the most practical for this facility would be a battery-type hydraulic lift. We recommend that the District purchase one as soon as possible.

Below we list our preliminary opinion of the costs to implement the recommendations noted above. Depending on the actual scope of work, some economies of scale could lower the cost so a more accurate estimate could be formed during design development should there be a decision to progress to a schematic design phase. This opinion of cost does not include associated electrical work or the additional recommendations noted below.

Item	Estimate
Replace main drains	$ 35,000.00
Replace tile gutter with stainless steel perimeter system	$ 200,000.00
New regenerative media filter system	$ 125,000.00
New water chemistry & UV systems	$ 50,000.00
New starting platforms	$ 19,500.00
Clean pool interior	$ 4,500.00
New handicapped lift	$ 6,000.00
New source-capture chloramine exhaust system (plenum only)	$ 84,000.00
New automatic water level control)	$ 2,5000.00
New timing system conduit infrastructure	$ 20,000.00
Total	**$ 546,500.00**

Appendix – Documentation of Specific Observations

Natatorium Space

Overall Appearance: Very good – pool was empty at time of inspection.

Roof construction: Precast concrete tees
Condition: Good so far as could be observed.

Deck Surface: Mosaic ceramic tile
Condition: Good.

Acoustics: Good, ceiling-mounted panels in place.

Lighting Type: Light Pipe style direct/indirect lighting over water.
Light Level: Could not be determined – several fixt5ures required re-lamping.

Deck Drains: Spot drains spaced at low spots around deck. Effectiveness could not be observed.

Depth Marking Description: Deck - Mosaic ceramic tile assemblies on deck and with 6" X 6" *No Diving* tiles added.
Inside pool – Mosaic ceramic tile assemblies on gutter backsplash
Depth markings must be placed every twenty-five feet around the pool or when the depth increases by two feet. The existing markings largely satisfy this requirements except for the markings at two-foot changes. Ideally these should be added.

HVAC System: Mechanical dehumidification
Condition: Said to be in fair condition
Type ductwork: Aluminum or stainless steel. The ductwork is not original to the space and it appeared to be in good condition.
Readings during inspection: Since the pool was empty and the dehumidification system was off-line, room temperature and humidity levels were not recorded.

Timing System: Very basic *Colorado Timing Systems*, no conduit infrastructure

Pool Shell

Overall Dimensions or SF: Approximately 42' X 75', 3,150 SF
Shallow end depth: 3'-6" (per depth markings)
Break depth: 4'-0" (per depth markings)

Deep End Depth: 10'-0" (per depth markings)

Starting Platforms present? Yes, fixed, low-height, fair condition. Manufacturer not known.
Water Depth @ Platforms: 10'-0" (per depth markings)
Comments: Platforms are not readily removable, no safety cones or other protective barriers.

Diving stands present? None.

Type perimeter overflow: Shallow, fully recessed ceramic tile gutter w/ periodic gutter drains.
Dimensions: 6" X 6½" channel, 14" freeboard.

Pool Shell Construction: Cast-in-place concrete with perimeter pipe tunnel.
Condition: Generally good so far as could be observed.

Main Drains: Two, ferrous metal sumps with Lawson 23" X 29", VGBA-compliant grates each rated at 878 GPM with a 10-year replacement cycle.
Comments: The drain sumps and outfall piping are very badly deteriorated and must be replaced..

Interior finish: 1" X 1" Mosaic ceramic tile
Condition: Very good

L G Chairs Type & Quantity: One fixed chair

Handrails/Ladders/Grabrails - Type & Quantity:
- Handrails – N/A
- Ladders – Recessed treads with grab rails in each corner.
- Stanchions – None.

Type Vacuum/Cleaner: Robotic – said to be in good condition

Safety/Maintenance Equipment General Notes:
- No handicapped lift was on hand, staff reports that they "borrow" one when needed
- Safety equipment was on hand.

Filter Room

Filter(s) Size & Type: *Neptune Benson* vacuum diatomaceous earth filter elements within an open, fiberglass tank.
Condition: The tank appeared to be in fair condition.
Comment: The existing filter system is a vacuum diatomaceous earth type consisting of an open concrete tank in the below-grade filter room. This system relies solely on an automatic, pilot-actuated diaphragm valves to prevent the filter tank from flooding during use or to keep the pool from emptying into the filter room when the recirculation pump is turned off or during a power failure. While fairly reliable, such mechanical devices occasionally fail resulting in a flooded filter and sometimes the filter room if the overflow line and outfall are compromised. We note that the filter room includes high-voltage electrical equipment.

The current ANSI pool cod requires a recirculation rate of at least 419 GPM for this pool. The current filter system is capable of a maximum flow of 336 GPM. *(Based on manufacturer's maximum recommended flow rate)*

Our firm does not condone the use of below-grade open filter tanks of any kind due to the propensity for the type of mechanical failure described above and the ensuing life-safety and property damage hazards. In this case the filter room is in a basement area. Property damage aside, if the aforementioned mechanical valve were to fail while District personnel were in the room where high voltage power is present, the risk of serious injury or fatality due to electrocution or even drowning are significant.

Recirculation Pump(s) Size & Type: Marlow, close-coupled, end suction.
Motor: 7½ HP, 3-phase
Condition: Fair

Pump Strainer(s) Size & Type: *Mer-Made* fiberglass 6" X 6" (Two – one on influent main drain line and one on gutter line)
Condition: Good
Extra Baskets: Yes

Flow Meter Type & Condition: None observed

Heater Type: Not Observed.
Condition: Said to be working properly

Water Chemistry Controller: CAT 2000
Condition: Not observed – not in operation

Chlorine Feeder Type & Condition: *Stenner* model 45M5, 50 GPD, systolic style liquid chlorine feed pump feeding directly from a closed, 160 GAL chlorine tank. Appeared to be in good condition.

pH Feeder Type & Condition: *Stenner* model 45M5, 50 GPD, systolic style liquid feed pump feeding directly from covered acid vat or directly from 5-gallon acid containers. Appeared to be in good condition.
Comment: Acid (muratic) vat is filled manually from 5-gallon containers. This practice is awkward and would appear to invite spillage of a hazardous material or injury to operating personnel. The acid pump seems large for the purpose and should be replaced if staff has difficulty with over-feeding. The District may wish to consider changing to carbon dioxide for pH control.

Chloramine Control Type & Condition: None

Piping – Type & Overall Condition

- Original piping in the filter area and around pool in pipe tunnel has been replaced with PVC which is in good condition. It appears that the filtered water supply piping through the pool wall has also been replaced with PVC. The original gutter outfall piping imbedded in the pool wall appears to still be in place.
- The existing main drain piping influent to the filter is the original ferrous metal which is badly deteriorated. All other filter piping has been changed to PVC.

Valves – Type & Overall Condition

- Mixed PVC and steel – Newer valves are PVC and are in good condition, original valves from the main drains are original and are not operational, essentially abandoned in place, stuck in operational mode. Staff has developed methods to cope with their status.

Respectfully submitted 14 October 2016 by;

John D. Bray, LEEDga, President