Kiel High School

Swimming Pool Audit

COUNSILMAN • HUNSAKER
The Ultimate Aquatic Advantage

July 17, 2013

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A. EXECUTIVE SUMMARY

Counsilman-Hunsaker was commissioned by the Kiel School District to provide a swimming pool audit for the competition pool at the Kiel High School natatorium in May 2013. The facility was originally constructed in 1970. With the facility over 40 years old, several elements within the facility are in need of repair, maintenance, or replacement. The purpose of the audit was to evaluate the existing pool and structure, its mechanical systems, and to provide an opinion of probable cost for items identified in need of maintenance or repair in the near future. Carl Nylander with Counsilman-Hunsaker met with Kiel High School staff that provided history and background in preparation of the evaluation and this report. This report relies on not only visual observations, but also a combination of estimated data provided by those intimate with operations of the facility and Counsilman-Hunsaker's experience from observing similar facilities.

Some improvements have been made to the pools and mechanical systems over the years including the replacement of the main drain covers to be compliant with the federal Virginia Graeme Baker Act, repair of some tile and corrosion, replacement of the pool recirculation pump and filtration system, and likely some if not all of the components of the timing system.

The area of most concern would certainly be the condition of the pool structure itself. From the pool deck there appear to be little concerns, only some corrosion that has likely bled through from the reinforcing steel. However, in the tunnel around the perimeter of the pool, there are significant structural cracks, many of which correspond with joints placed when the pool was initially constructed. Nearly all cracks and other penetrations of the pool shell (piping, lights, etc.) indicate calcification and bleed-through of chlorinated water despite attempts to patch and waterproof the shell. The staff did not report any observed water loss in the pool itself, but it's likely that some is occurring. It is recommended later in this report to install a water meter on the domestic water line feeding the pool to get a better understanding of the situation.

The other area of concern is concerning the water chemistry in the pool. The pool feed pumps were disabled and not feeding chemicals and it's assumed this is all taking place by hand since there were certainly measurable chemical levels in the pool during the site inspection. The water is in an extremely aggressive condition and it's recommended that once the pool is drained during the next scheduled maintenance interval, the pool will require acid washing and close attention will need to be paid to the chlorine levels, pH readings, total alkalinity, and calcium hardness to ensure that a recommended water chemistry balance is maintained.

A comprehensive list of the items referenced within this report as in need of repair or replacement or renovation are itemized in the opinion of probable cost section at the conclusion of this report.

All references to the regulations of the health department in this report refer to Chapter SPS 390 of the State of Wisconsin Administrative Code for the Design and Construction of Public Swimming Pools and Water Attractions last dated in February 2012.

B. POOL INFORMATION

1. Competition Pool
    a. Dimensions – 75’-0” long by 42’-6” feet wide
    b. Surface Area – 3,214 square feet (SF)
    c. Depth – 3’-6” to 10’-3” at the deep end
    d. Number of Lanes – Six 25 yard lanes
    e. Lane Width – 7’-0” wide with 3” buffers on the outer lanes
    f. Volume – approximately 116,375 gallons
    g. Perimeter – approximately 275’-0”
    h. Turnover Rate – approximately 4 hours and 20 minutes
    i. Design Flow Rate – approximately 450 gallons per minute (GPM)
    j. Filtration Area – 27.6 square feet
    k. Filtration Rate – 16.3 GPM/SF
    l. Diving – One 1-meter diving board

*Dimensions and volumes not confirmed but taken from data provided.

C. POOL ITEMS

1. **Structure and Finish**
2. **Pool Tunnel**
3. **Perimeter Overflow System**
4. **Main Drains**
5. **Inlets**
6. **Underwater Lights**
7. **Safety Lines**
8. **Ingress and Egress**
9. **Markings and Anchors**

CH Observations, Comments and Recommendations:

1. Structure and Finish

Observations and Comments:

a) The competition pool finish was all ceramic tile. A few 1x1 tiles were missing in the shallow end of the pool.

b) There was some missing grout in areas and some lime build-up, primarily around the return inlets in the center of the pool.

c) There was some rust bleed-through at a couple locations inside of the pool, primarily at the waterline and in the cove. Staff reported that these areas showed bleed through in the past which led to re-tiling and grouting these locations, but the rust has bled back through the tile quickly. This is indicative of a compromised concrete shell where the chlorinated water is coming in contact with the reinforcing steel in the pool structure.

d) On the negative side of the pool, in the perimeter tunnel, several significant cracks in the pool structure were observed. The largest cracks were lined up with the interface between the pool floor and wall and the pipe and underwater light penetrations. There was also a large vertical crack on the backside of the pool. Based on the other cracks, it's assumed that this was the location of a construction joint formed during the installation of the pool. All cracks had evidence of calcification build-up.

Recommendations:

a) The clear location of almost all of the cracks indicates that there was improper installation (materials or placement) of waterstops during initial construction or they were omitted altogether. Remediation of this condition is likely not a practical option due to the extent of the cracking. It is very likely that the pool tank itself is not in any immediate threat of catastrophic failure, however, it may be prudent for the school district to have a licensed structural engineer inspect the pool shell for its structural integrity.

b) The pool tile should be re-grouted at minimum where the grout is absent, likely due to the water chemistry in the pool and low calcium hardness (no calcium hardness was measured in the pool at the time of the audit). When water has low calcium content, the pool water will become increasingly more aggressive towards cementitious products, like grout.

c) All missing 1x1 tiles should be replaced, especially in the shallow water areas and any walls that may be a safety issue.

d) The areas where corrosion was observed in the pool tank should be thoroughly remediated by removing the finish, routing out around the corroded areas, epoxy injected, and refinished.

Image 5: Crack in the Pool Structure

Image 6: Crack in the Pool Structure and Calcification

Image 1: Crack in the Pool Structure

Image 2: Crack in the Pool Structure

Image 3: Pool Leak Emanating from Pool Piping

Image 4: Vertical Crack in the Pool Structure

Image 11: Pool Leak at Light Niche

Image 12: Missing Tiles in the Shallow End

Image 7: Crack in the Pool Structure

Image 8: Vertical Crack in the Pool Shell at the Interface of the Sloped Deep End Floor and the Pool Wall

Image 9: Crack in the Pool Structure

Image 10: Crack in the Pool Structure

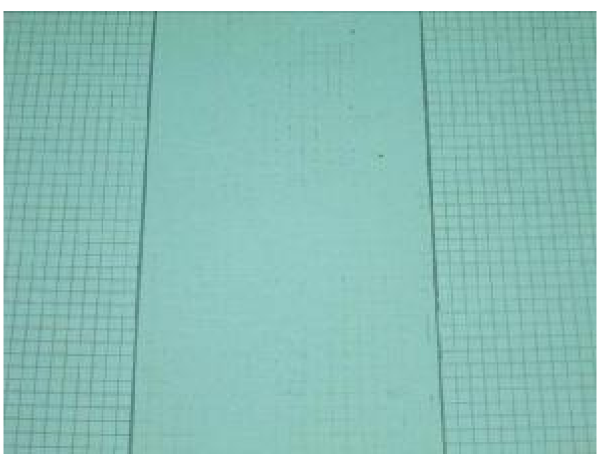

Image 13: Lime Build-Up and Missing Grout

Image 14: Corrosion at the Water Line Handhold

Image 15: Calcium Build-Up on the Rollout Gutter Curb above the Water Line

Image 16: Corrosion at the Water Line Handhold

2. Pool Tunnel

Observations and Comments:

a) There was significant corrosion noticed around the underwater viewing window along with structural cracks emanating from the window in the pool shell.

b) An ABC-type fire extinguisher was observed in the pool mechanical area. ABC-type extinguishers are volatile around pool chemicals.

c) Many of the metallic items, especially in the corridor exposed to the surge tank access are significantly corroded.

d) In the pool tunnel, calcified stalactites were observed below the pool deck indicating that the deck slab is being compromised by chlorinated water likely due to either a lack of a waterproofing membrane on top of the deck slab or compromises in an installed deck waterproofing membrane.

Recommendations:

a) If the pool is drained completely for maintenance purposes, consideration should be given to removing the underwater window and filling it with concrete and doweling into the existing structure with reinforcement. The staff reported that the window had to be replaced a number of years ago due to a bather puncturing it from inside of the pool. If this is true, it could pose a serious risk to bathers. And with the removal of the second diving board, this window likely serves very little practical purpose today. If it's used for underwater viewing and stroke observation, there are a number of inexpensive video recorders that can be used to observe swimmers underwater strokes from the deck.

b) The ABC-type fire extinguisher should be replaced with one that is water-based.

c) All severely corroded items in the pool tunnel should be replaced. Refer also to the surge tank section of this report.

d) Should the deck ever require re-tiling, a 100% waterproofing membrane should be provided below the deck tile continuous without gaps or holidays to ensure that chlorinated water would not bleed through to the tunnel in the future.

Image 17: Tunnel Corridor with Exposure To the Surge Tank

Image 18: ABC-type Fire Extinguisher in the Pool Tunnel Area

Image 19: Corrosion and Cracks around the Underwater Pool Window

Image 20: Stalactites from the Underside of the Pool Deck

3. Perimeter Overflow System

Observations and Comments:

a) An open-faced concrete and tile rollout gutter is provided along the two lengths of the pool and the shallow end wall. A full concrete and tile parapet (12" high and 18" wide) is provided at the deep end of the pool. This perimeter overflow gutter serves as the means for recirculating the pool water at the surface back to the filtration system. No grating is provided over the gutter.

b) There are a total of 16 dropouts, each connected to 2" pipes, which returns overflow water to the surge tank. At 3 ft/sec, each dropout is capable of approximately 31 GPM of flow. Therefore, with 16 dropouts, the perimeter overflow system is sized to handle 100% of the designed recirculation rate which is per current industry standards.

c) There gutter trough itself is only a few inches deep and has minimal capacity. While it can handle the quiescent recirculation conditions, when competitions are held in the pool, the gutters likely return a lot of wave rebound from swimmers' wake into the pool creating choppier conditions and therefore a "slower" pool.

d) As noted previously, there was some corrosion evident around the gutter handhold in a few areas.

e) The dropouts were metallic and showed signs of corrosion.

Recommendations:

a) The areas where corrosion was observed in the pool tank should be thoroughly remediated by removing the finish, routing out around the corroded areas, epoxy injected, and refinished.

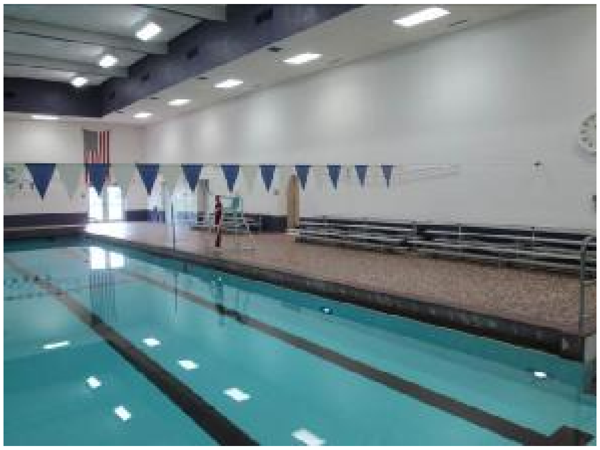

Image 21: Rollout Perimeter Overflow Gutter along the Length of the Pool

Image 22: Metallic Gutter Dropout and Handhold Corrosion

Image 23: 2” Gutter Lip Handhold

Image 24: Deep End Wall Parapet

4. Main Drains

Observations and Comments:

a) One large main drain cover was installed over the main drain sump. It appeared to be an Aegis drain cover, supplied by Neptune-Benson. The Aegis cover is Virginia Graeme Baker approved for flow rates up to 600 GPM at a velocity up to 1.5 ft/sec.

Recommendations:

a) Based on the competition pool flow rate of 450 GPM, the suction outlet is properly designed per the federal Virginia Graeme Baker Act. However, because there is only a single suction outlet, a vacuum release device (SVRS) should be installed on the suction side of the pool pump. And per VGBA, the suction cover is required to be replaced at the end of its useful life as stated by the manufacturer (typically 7 to 15 years). This information should be on the cover of the drain grates, so the owner should confirm the next time the pool is drained for maintenance.

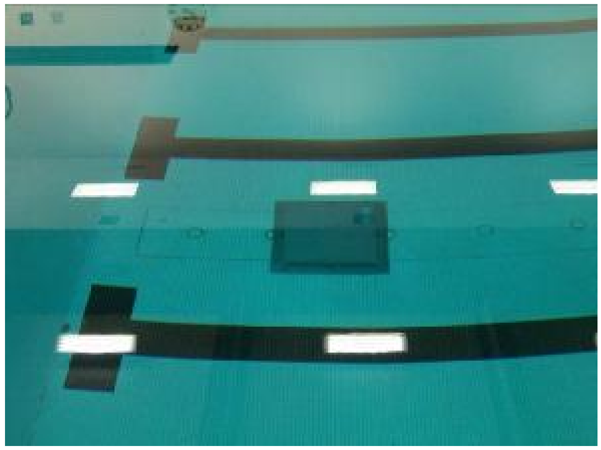

Image 25: Pool Main Drain Cover

5. Inlets

Observations and Comments:

a) PVC adjustable floor inlets were observed centrally located in the competition pool.

b) 20 inlets were installed. Based on the designed recirculation rate, each inlet has a flow rate of approximately 22.5 GPM assuming that the fittings have been adjusted for even flow distribution.

Recommendations:

a) The floor inlets in the competition pool should be verified that they are balanced during the next scheduled maintenance to ensure optimal flow distribution. Assuming that the pumps were not designed for high exit pressures at the inlets, the competition pool inlets should be ½ to ¾ turns open given the lower flow rates per inlet. Or, if there are areas in each pool that are known to collect dirt and debris more frequently, nearby inlets can be adjusted to move more recirculation water in these parts of the pool.

Image 26: Pool Floor Return Inlets

6. Underwater Lights

Observations and Comments:

a) Underwater lights were installed in the competition pool and observed to be operational.

b) A total of 12 underwater lights are installed in the competition pool. The wattage of each light was unable to be confirmed, but assuming each is capable of 300 Watts, approximately 1.1 Watts per square foot of lighting is provided in the pool.

c) As previously noted, several of the underwater light niches were observed to be leaking in the tunnel.

Recommendations:

a) Industry standard for lighting per square foot of pool surface area is a minimum of 0.5 W/SF. However, 1.0 W/SF has proven to be more effective. When at least 0.5 W/SF of light is provided underwater, a minimum of 10 footcandles of light is required by local code overhead.

b) If the underwater lights and niches are ever replaced, dry niche fixtures will be necessary, otherwise conduit will need to be somehow routed above water level. Any niche should be provided with an integral waterstop and well grouted around the fixture.

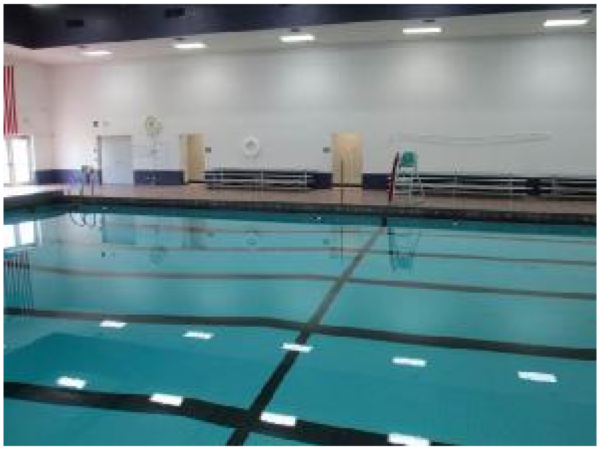

Image 27: Swimming Pool Underwater Lighting

Image 28: Underwater Light

Image 29: Dry Niche and Backside of Underwater Light

7. Safety Lines

Observations and Comments:

a) A 6" wide contrasting tile band is provided at the 5'-0" depth contour break which is the demarcation between shallow water and deep water and where the slope in the pool floor changes.

b) Two anchors, one on either side of the pool are provided on the vertical face of the rollout curb. These anchors are located directly on top of the contrasting tile line. There is also a green patina observed on both anchors.

Recommendations:

a) Should the pool ever require a complete re-tiling, code requires that the float rope be installed 1'-0" to the shallow side of the marking. The other option would be to move the anchors each 1'-0", but that would also require re-grounding the anchors. Due to its age, this pool is likely grandfathered from a current requirement like this unless there are major renovations planned or if the anchors would be replaced for cosmetic reasons.

Image 30: 5'-0" Depth Contour Safety Marking

Image 31: Safety Rope Anchor

8. Ingress and Egress

Observations and Comments:

a) Three sets of grab rails with recessed steps were provided around the competition pool perimeter along with a 5'-0" wide stair entry.

b) No handicap lift was noticed around the pool for accessibility. ADA access for all public swimming pools was recently signed into law on July 26, 2010, published in the Federal Register on Sept. 15, 2012, and went into effect on Mar. 15, 2011.

Recommendations:

a) The new ADA regulations will require that a primary means of access be provided and "readily available" at the competition pool for anyone that may require it. The two means of primary access would be a ramp entry (difficult to accommodate in an existing pool like this) or a handicap lift. While all handicap lifts for new pool construction require them to be anchored, there is a provision allowing portable lifts for existing pools. A secondary means of access is not required since the pool perimeter is less than 300 lineal feet.

Image 32: Shallow End Entry Stairs

Image 33: Deep End Grab Rails and Recessed Steps

9. Markings and Anchors

Observations and Comments:

a) Tiled depth markings were provided around the perimeter of the pool. All tiled markings are legible and in good condition.

b) In terms of message tile or warning signs, the only markings around the pool perimeter were for “Shallow” and “Deep” water. Current regulations require that “No Diving” signage alongside the international no diving symbol be provided at no more than 25 ft spacing intervals at all water depths less than 5’-0”. This is typically not an area where most health departments will grant a grandfathered exemption for existing pools.

c) Similarly, no vertical depth markings were installed, only the length of the race course is provided along the sides of the competition pool.

d) The racing line markings on the pool floor and wall were in good condition.

e) A patina was noticed at some of the grab rail and stair handrail anchors. This is typical for copper anchors.

Recommendations:

a) Provide “No Diving” signage with the international no diving sign around the shallow end of the pool (approximately five would be necessary), unless the department of health grants a specific exemption. Similarly, vertical depth markings should be provided around the entire pool perimeter consistent with SPS 390.18(2) unless specifically exempted. Waivers for the vertical depth markings may be possible if the current length markings are preferred to stay and the pool depths could be installed on the natatorium wall. This approach is commonly accepted in Illinois.

b) Anchors exhibiting patina only require replacement for aesthetic purposes.

Image 34: Grab Rails

Image 35: Green Patina on Deck Anchor

Image 36: Deck Message Tile

Image 37: Horizontal Depth Marking

Image 38: Vertical Markings for Pool Length

Image 39: Lane Wall Targets

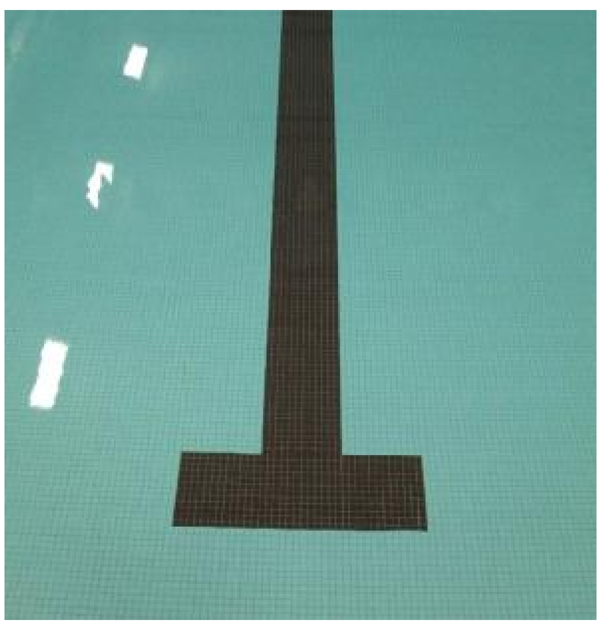

Image 40: Lap Lane Floor Marking

D. DECK ITEMS

1. **Deck**
2. **Diving Boards**
3. **Starting Blocks**
4. **False Start & Backstroke Stanchions**
5. **Safety Equipment**
6. **Deck Equipment**

CH Observations, Comments and Recommendations:

1. Deck

Observations and Comments:

a) The perimeter tile deck band around the competition pool is 1x1 tile and in decent condition. As noted previously, there is some leaking evident in the tunnel around the pool coming from the deck. There was also some signs of discoloration due to the chlorinated water at the deck around the grab rails and stair entry.

b) The deck widths were approximately 11’-2” at the shallow end of the pool; 15’-4” (including the 2’-0” parapet) at the deep end; 6’-8” along the far side of the pool; and 16’-4” at the spectator seating side of the pool.

Recommendations:

a) The discoloration of the tile due to the chlorinated water should be able to be cleaned, but likely not to a “new” condition. The areas of the pool frequently used for ingress and egress can be washed or cleaned more frequently to discourage additional discoloration.

b) The deck width behind the diving board is currently at a minimum. No action is necessary, but should be kept in mind for future equipment replacement or renovations.

c) As noted previously, if the deck tile is ever to be entirely replaced, a continuous waterproofing membrane should be applied without gaps or holidays to prevent stalactites forming in the tunnel. Soft joints should be installed for the pool perimeter tile as recommended by TNCA standards and method EJ171 which require joints to be spaced at least 20’ – 25’ on center. Additionally, soft joints should be installed on top of any cold or construction joints.

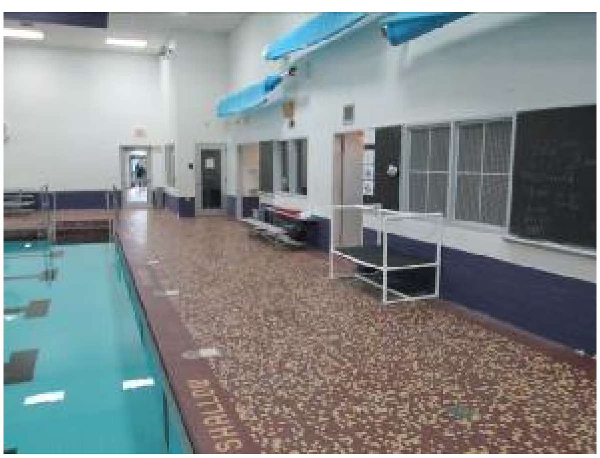

Image 41: Shallow End Pool Deck

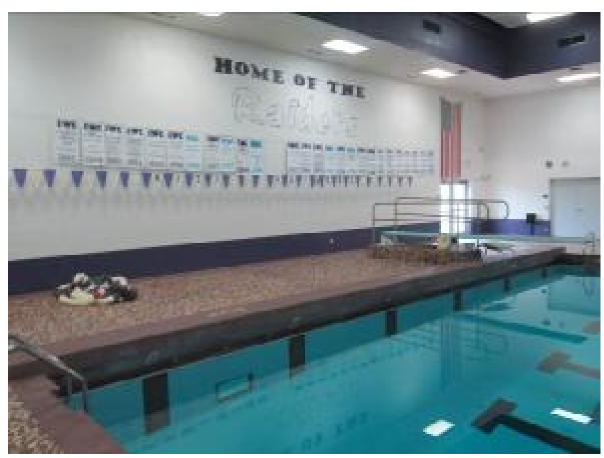

Image 42: Deep End Pool Deck

2. Diving Boards

Observations and Comments:

a) The deep end of the competition pool contains one 1 meter diving board. There appears to have been a second diving board, perhaps a 3 meter springboard, on the other side of the deep end that has been removed over time.

b) There was some delamination on the springboard itself and the stand as well as some corrosion.

c) Current National Federation of State High School Associations (NFSHSA) regulations require a minimum plummet depth of 12’-0” for 1 meter diving and the State of Wisconsin requires a minimum depth of 11’-0”. The dimensions from the centerline of the diving board to the slope break and to the side wall also fall short of both of these minimum standards. Often these can be considered for grandfathered situations with local health departments, but not always. Also, there is typically a significant insurance premium that these older facilities have to pay to their providers if they don’t meet current local and industry standards. It is what has led to many facility’s determining that the best path forward is to simply remove the diving board(s).

Recommendations:

a) Inquire with local health department official if a grandfathered exemption is possible to the current envelope profiles for the State of Wisconsin and the NFSHSA standard.

b) Determine if there are premium penalties assessed by the insurance provider and if it is preferred to continue diving or eliminate the board.

c) If diving will be continued in light of the first two items, consider if the diving board should be moved towards the middle of the pool to help mitigate some of the lateral clearance issues to the side wall. Doing so would require a new diving pedestal and the diving board will need to be bonded. Any relocation will need to be verified with a structural engineer and the loads anticipated on the deck.

d) Replace the diving board and stand within 5 years as delamination and corrosion worsens.

Image 43: One Meter Springboard

Image 44: Diving Board Stand and Railings

Image 45: Inadequate Depth Profile at Diving Board Plummet

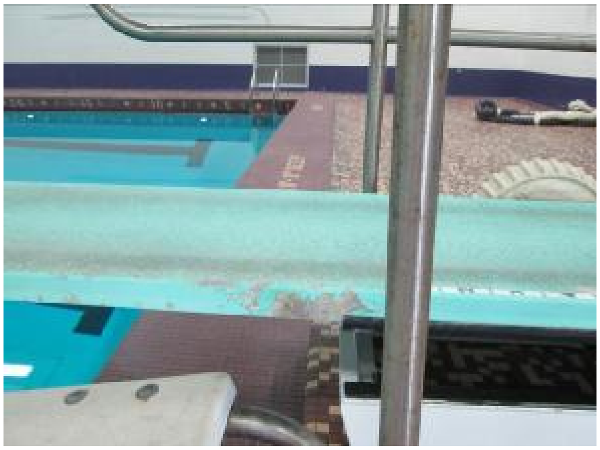

Image 46: Delamination of Diving Board Board

Image 47: Lateral Clearances for Diving

3. Starting Blocks

Observations and Comments:

a) The starting blocks for the competition pool were stainless steel and dual post. Only one block was installed and observed during the inspection. This block appeared to have a custom and permanent installation due to the location of the diving board.

b) Some mild corrosion was observed on the stainless steel posts of the starting blocks.

c) The starting block observed was installed 29” above water level which meets NFSHSA regulations.

d) Similar to the other deck anchors there was a green patina observed at the anchor sockets.

e) There were anchors at the shallow end of the pool, but no starting blocks were installed. There was also conduit assumed to be for a timing system at this end of the pool coming through the concrete in the tunnel. The minimum water depth under starting blocks per NFSHSA is 4’-0”.

Recommendations:

a) All stainless steel in the natatorium above the waterline, including the starting blocks, should be a part of regular maintenance. They should be wiped down regularly with approved stainless steel cleaner such as SpectraClean provided by Spectrum Products. More established, set-in corrosion will have to be cleaned more aggressively with other means.

b) Due to the 3’-6” water depth at the shallow end of the pool, it is recommended that starting blocks not be used at this end due to noncompliance with NFSHSA and industry standard.

Image 48: Starting Block

Image 49: Mild Corrosion on Stainless Steel Starting Block Posts

Image 50: Patina at Starting Block Anchors

4. False Start & Backstroke Stanchions

Observations and Comments:

a) Backstroke pennants were installed, but rather than being anchored to the deck via stanchion posts, they were anchored to the natatorium wall and the cable is tightened using a spool and ratchet.

b) There were short stanchions near the 5’-0” depth contour that are assumed to be used for a false start rope that was not observed. There was corrosion evident on the stainless steel stanchion posts.

Recommendations:

a) All stainless steel in the natatorium above the waterline, including the stanchion posts, should be a part of regular maintenance. They should be wiped down regularly with approved stainless steel cleaner such as SpectraClean provided by Spectrum Products. More established, set-in corrosion will have to be cleaned more aggressively with other means.

Image 51: Backstroke Flags and Location

Image 52: Anchor Connection for Backstroke Cable

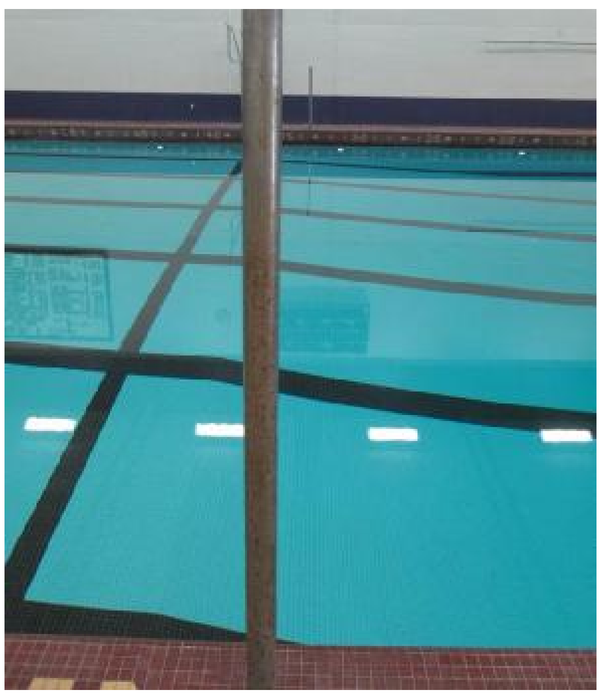

Image 53: Corrosion on Stanchion Post

5. Safety Equipment

Observations and Comments:

a) One spineboard was observed propped up against the natatorium wall along with two ring buoys, two life hook and telescopic poles, two resucue tubes, and a safety eyewash station.

b) The lifeguard office was locked and closed, but it should be confirmed that it includes a first aid kit and an emergency phone.

c) Pool rules signage was mounted on the natatorium wall.

d) One of the life hook (Shepherd's hook) poles that was hung on some mounting brakcets on a natatorium wall was significantly bent.

e) A Taylor test kit was available off of the pool deck for monitoring pool water chemistry.

Recommendations:

a) Replace the telescopic pole that is bent for the mounted Shepherd's hook.

b) Verify that a well-stocked first aid kit and emergency phone is provided in the lifeguard office.

Image 54: Bent Wall Mounted Shepherd's Hook

Image 55: Wall Mounted Ring Buoy with Extension Rope

Image 56: Spineboard

6. Deck Equipment

Observations and Comments:

a) Other than the starting block and diving board which have been already addressed, the only other pool deck equipment observed were the 4” diameter lane ropes and single storage reel, a portable water basketball goal, three “tot docks” for instruction, two lifeguard chairs, and two 31” diameter battery-powered pace clocks. All of this equipment appeared in good working condition.

b) A timing system is provided for the competition pool. It was unable to discern for certain how the timing system operated during meets. It appeared that conduit had been installed at the shallow end of the pool for touchpads at one point in time and has since been abandoned since starts no longer appear to take place from that end of the pool. There are no deck plates at the deep end of the pool, so a wire harness likely runs on top of the deck during meets for the touchpads to plug into. There was a wall plate for the starter to connect to along with a digital, two-line LED scoreboard.

c) A motorized pool cover is provided for the swimming pool. It was not confirmed whether or not this pool cover is in fact operational. Some corrosion was noted on the motor housing for the automated covers.

Recommendations:

a) The lane ropes appeared to be in decent condition. It is recommended that a spare rope be kept on site in the event one is broken at an inopportune time.

b) The pool cover should be confirmed operational. The pool was closed at the time of the site inspection, so it's assumed that the cover is not utilized as it was intended for energy savings.

Image 57: Shallow End Deck Plate

Image 58: Colorado Time Wall Plate

Image 59: Timing System Scoreboard

Image 60: Battery-Powered Pace Clock

Image 61: Pool Covers

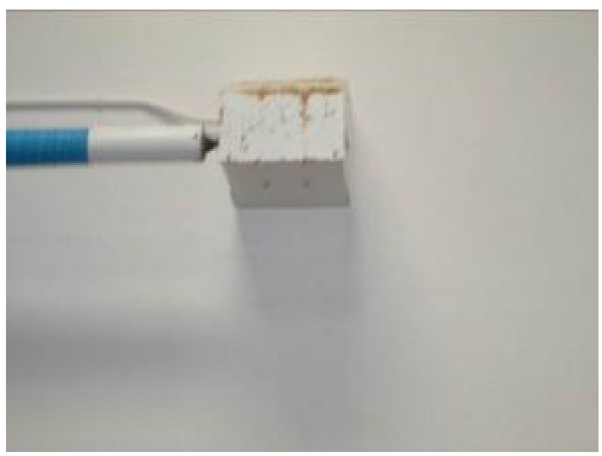

Image 62: Motor for Pool Covers

Image 63: Portable Lifeguard Chair

Image 64: Permanent Lifeguard Chair

Image 65: Old Deck Plate Wiring at Shallow End

E. POOL MECHANICAL ITEMS

1. **Piping**
2. **Pump**
3. **Filtration**
4. **Valves**
5. **Surge Tank**
6. **Chemical Treatment**
7. **Chemical Controller**
8. **Make Up Water**

CH Observations, Comments and Recommendations:

1. Piping

Observations and Comments:

a) The pool process plumbing that was observed in the mechanical room was in good condition. The majority of the piping had been replaced in the recent years with Schedule 40 PVC. The only cast iron piping that remains are the connections through the floor slabs and pool walls as well as the piping below the pool floor. The cast iron piping that could be observed was significantly corroded.

b) All of the pipe hangers were severely corroded, primarily as a result of sharing a space with the pool chemicals and the surge tank open to the pool tunnel. A couple of the pipe hangers were corroded to the point of failure.

c) One impact flow meter was provided for the recirculation system and was reading 450 GPM. There was also a digital flow meter that appeared inoperable. There was no flow reading on the digital readout and the totalizer was constant as well. There was no flow meter on the backwash piping.

d) The main drain suction line is 6" and the throttling valve on this line was almost completely closed. For Schedule 40 PVC piping, the maximum allowable flow rate by code is 540 GPM at 6 ft/sec, which is the maximum velocity allowed by code for suction piping. Should the piping ever be changed to more durable Schedule 80 PVC in the future, this would be an option as well on the suction side if the same recirculation rate is maintained as the maximum allowable flow rate would be 487 GPM. The suction line from the surge tank to the recirculation pump is 6" as well.

e) The discharge side of the pump and main filtered water distribution line is 6" as well. For Schedule 40 PVC piping, the maximum allowable flow rate by code is 900 GPM at 10 ft/sec, which is the maximum velocity allowed by code for suction piping. Should the piping ever be changed to more durable Schedule 80 PVC in the future, this would be an option as well on the suction side if the same recirculation rate is maintained as the maximum allowable flow rate would be 812 GPM.

f) The main dropout line returning to the surge tank is 6". Code does not speak to maximum velocities in gravity piping, but general convention in the pool industry is to assume 3 ft/sec. For Schedule 40 PVC piping, the maximum flow rate at this velocity would be 270 GPM, below 100% of the recirculation rate for the pool. As mentioned previously, the individual 2" pipes are sized properly, but this main gutter return line could be upsized to an 8" based on the flow rates.

g) The backwash line is 6" as well. The backwash flow rate for these filters should be 103.5 GPM based upon a backwash rate of 15 GPM/SF. A 6" line, in terms of flow rates, is large enough to handle the backwash velocities even if all four filter tanks were backwashing at the same time. However, this practice is generally not applied and it is unknown if the sewer could handle these high flow rates.

Recommendations:

a) The surge tank suction and main drain suction should be confirmed to be properly balanced. Typically, 80% of dirt, debris, oils, etc. will remain at the surface of the pool and 20% will accumulate on the bottom. So the surge tank and main drain valves are throttled accordingly.

b) Epoxy coated pipe hangers should replace the corroded hangers throughout the basement area.

c) If it's ever accessible for any reason, the cast iron piping should be replaced below grade with Schedule 80 PVC. The condition of the below pool cast iron piping will not be able to be ascertained without a pressure test or a camera scope. Cast iron pool piping from newer pools than the one at Kiel HS have failed due to corrosion, but at the same time, pools older than Kiel HS are still in operation without any leaks. Projecting the future life of this pipe would be pure speculation, but assuming more than an additional 15-20 years would be unadvised.

d) An impact flow meter should be provided on the backwash line. Flow meters from Blue-White, similar to what is provided on the return line, are typically acceptable.

Image 66: Suction Piping

Image 67: Corroded Mechanical Room Pipe Hangers and Supports

Image 68: Piping and Hangers near Surge Tank

Image 69: Sch 40 PVC Gutter Piping at Pool Perimeter

Image 70: Gutter Dropout Penetration

Image 71: Main Drain Suction Piping

Image 72: Return Piping and Valve

Image 73: Corroded Pipe Support

Image 74: Example of Corroded Pipe Hanger Failure

Image 75: Impact Flow Meter for Filtered Water Return

Image 76: Digital Flow Meter

Image 77: Gutter Dropout Penetration

2. Pumps

Observations and Comments:

a) Corrosion was evident on the exterior of the pool pumps, but to a much greater degree on the concentric and eccentric reducers connecting to both sides of the pump as well as the hair and lint strainer. The strainer basket is so heavily corroded that it may be difficult to change. It was not verified by staff how frequently this takes place.

b) While it was unable to discern the age of the recirculation pump, it appears to have been replaced in the last several years. The pump itself is a Sta-Rite pump with a 15 hp motor from Leeson. The pump name plate information is illegible. The pump was well anchored to a concrete housekeeping pad.

c) The pump did not have pressure or vacuum gauges installed.

d) There was some standing water observed under one of the hair and lint strainers. This may have come from the drain port in which case it should be fixed. Or if the strainers were recently cleaned, this may have just been some residual water from that cleaning. It was reported that the strainer baskets are cleaned monthly.

Recommendations:

a) The recirculation pump will inevitably need to be replaced in the future. If it's sized properly with the losses in the system and is operating at its design point on the pump curve, this pump could see an additional 5-10 years of service. When the pump is replaced, it should be replaced with one that has an internal coating of Scotchkote 134 to protect the pump from the pool chemicals and corrosion.

b) Provide a vacuum gauge on the suction side of the pump that reads in inches of Mercury and a pressure gauge that reads in PSI on the pump discharge. These gauges should be installed in the ports provided close to the pump for the most accurate readings.

c) The hair and lint strainer should be replaced at the next scheduled maintenance interval and the reducers should be replaced as well on both sides of the pump. A fiberglass strainer is preferred or an epoxy coated stainless steel strainer. The reducers should be replaced with ones made from PVC.

Image 78: Pump Starter

Image 79: Corroded Hair and Lint Strainer and Reducer

Image 80: Recirculation Pump and Base

Image 81: Pump Tap for Pressure Gauge

3. Filtration

Observations and Comments:

a) Pressure high rate sand filters are used for filtering the competition pool. The filtration areas are 6.9 SF per tank. With four tanks, this results in a total filter area of 27.6 SF and a filtration rate of 16.3 GPM/SF for the competition pool. While the filters are rated up to 20 GPM/SF, it's typically advised by most commercial filter manufacturers to maintain filtration rates between 12.0 GPM/SF and 15.0 GPM/SF.

b) The filters are provided with a manual backwash operation.

c) A leak was observed at the spa filter tank. Its source was not identified.

d) The filters have been replaced, though it's not known when. It's likely that they are no more than 5-10 years old.

Recommendations:

a) Most high school competition pools that utilize pressure high rate sand will utilize larger filtration tanks with deeper sand bed depths for better filtration and tanks with ratings of 100 PSI (current filters have 50 PSI ratings). However, replacement of the current filters in the future may dictate that similar tanks are used since only a single door provides access to the basement.

b) If the media in the filter tanks has not been replaced in the last 5 years, it should be at the next scheduled maintenance interval.

c) It appears that when the pool is drained, it is done so through the filter tanks and backwash mode. If this is the case, it is typically discouraged by filter manufacturers so that there isn't any "channeling" of the media. A tap into the filter return piping between the pump and the filter with a throttling valve could be plumbed to the sewer (with an air gap or backflow prevention) as an alternative.

d) Acknowledging that the exact age of the filter tanks are unknown and it was not feasible to inspect the interior of the filter tanks, including the laterals, until the next scheduled maintenance cycle, it is anticipated that the filter tanks will last another 5-7 years before they will require replacement. Further information on the interior of the tank could lead to a more defined life cycle expectation.

Image 82: Filter Butterfly Valve

Image 83: Filter Butterfly Valve

Image 84: High Rate Sand Filter Tanks

Image 85: Filter Tank Pressure Gauge

Image 86: Influent and Effluent Pressure Gauges

Image 87: Schedule 40 PVC Filter Face Piping

4. Valves

Observations and Comments:

a) The majority of the valves for the pool system are butterfly valves. They appeared to have been replaced at the same time that the accessible piping in the pool tunnel was replaced with Sch 40 PVC. There was some minor corrosion evident, again a result of the pool chemicals stored in this space and the surge tank's open access.

b) The check valve on the discharge side of the recirculation pump reportedly failed and caused a significant flooding in the pool mechanical basement recently. on the discharge side of the pumps are usually required to be installed five pipe diameters downstream from the nearest fitting. The check valves observed did not have this spacing.

c) Often chain operators are provided for valves above 7 feet, but unless they are not manipulated regularly, they aren't necessary.

Recommendations:

a) If the check valve is indeed not operating properly, it should be replaced at the next scheduled maintenance interval or more immediately if it is feasible. The check valve should be installed at least 5 pipe diameters downstream from the nearest fitting on the discharge side of the pump.

Image 88: Main Drain Suction Butterfly Valve

Image 89: Filtered Return Line Butterfly Valve

5. Surge Tank

Observations and Comments:

a) The surge tank was assumed to be at normal operating water level since the pool was closed to the public at the time of the site inspection. It was approximately 50% or 60% full.

b) The exterior dimensions of the surge tank are approximately 19'-3" x 11'-9" with an interior height of approximately 7'-6". This leaves an effective surge capacity of approximately 5,700 gallons based on the normal operating water depth observed. This exceeds the code minimum requirement of one gallon per square foot of pool surface area.

c) The access to the surge tank is open to the basement space. There was noticeable chemical off-gassing inside of the surge tank that is certainly the root cause of some of the corrosion issues in the surrounding space. The access ladder into the surge tank is certainly one example as it too has signs of advanced corrosion.

Recommendations:

a) Ideally, the access port currently utilized would be sealed. A simple pipe vent is the preferred means of venting a surge tank and alleviates pressure due to changing internal water volume. The vent would be piped to the exterior above the operating level of the pool.

b) The water level could be maintained at the current level so that the existing access point could still be utilized if it is sealed. Or an access hatch could be created in the deck slab. Any electric would need to be removed from this space. There was at least some conduit evident going to an abandoned light overhead.

Image 90: Interior of Surge Tank

Image 91: Surge Tank Water Level Control and Heater Temperature Readouts

Image 92: Surge Tank Drain

Image 93: Interior of Surge Tank

Image 94: Surge Tank Access and Ladder

Image 95: Surge Tank Overflow

6. Chemical Treatment

Observations and Comments:

a) The primary sanitizer for the competition pool is sodium hypochlorite (liquid chlorine). The primary pH buffering agent is muriatic acid, though it appears that CO_2 was used at one point in the past and has since been abandoned.

b) LMI pumps were in the pool mechanical space intended to deliver pool chemicals (liquid chlorine and muriatic acid) into the pool recirculation system. However, the storage drum observed was completely empty and the tubing at the chemical feed pumps was loose. So it was unknown if this is typically this way and chemicals are regularly added by hand, or if this was an anomaly.

c) There was no secondary containment for the pool chemicals or the empty storage container.

d) No chemical signage was present or MSDS sheets found for the areas where the chemicals are typically stored and distributed.

e) As previously noted, the open chemical containers and the fact that they are not stored in dedicated rooms with independent exhaust has contributed significantly to the corrosion evident on the fittings and hardware in the storage room and pool mechanical area as well as the access door, door jamb, and HVAC in the storage area.

f) Significant quantities of pool chemicals were stored on site. Maximum storage quantities depend on local jurisdictions. Sodium hypochlorite can sometimes be stored in quantities up to 500 or 1000 gallons under the right conditions (ventilation, fire rating, sprinkled, etc.).

Recommendations:

a) Secondary containment should be provided for the open chemicals that are in use or in process. This can be done with a double walled tank or using a spill platform. Eagle and Chemtainer are two good sources. The connection points into the chemical tanks for the chemical pump tubing should be tight to prevent off-gassing.

b) The chemical feed pumps should be properly installed to regulate chemical delivery as determined needed by the water chemistry controller.

c) MSDS sheets and chemical signage should be provided where pool chemicals are stored. Verify the permitted storage quantities based on local building codes.

d) A medium pressure UV system could be considered for the competition pool. UV will serve as a secondary sanitizer and help control chloramines in the natatorium. This will result in better air quality in the natatorium, reduced corrosion on metallic items above water level, and generally longer life expectancies on building structures and air handling units.

Image 96: Pool Chemical Feed Location

Image 97: Empty Chemical Storage Tank

Image 98: Chemical Feed Pump and Tank

Image 99: Abandoned CO_2 Feed System

Image 100: Chemical Feed Pump

Image 101: Chemical Storage and Corroded Door and Frame

Image 102: Corrosion in Chemical Storage Area

Image 103: Lime Solvent

Image 104: Chlorine Reducer

Image 105: Chlorine Neutralizer

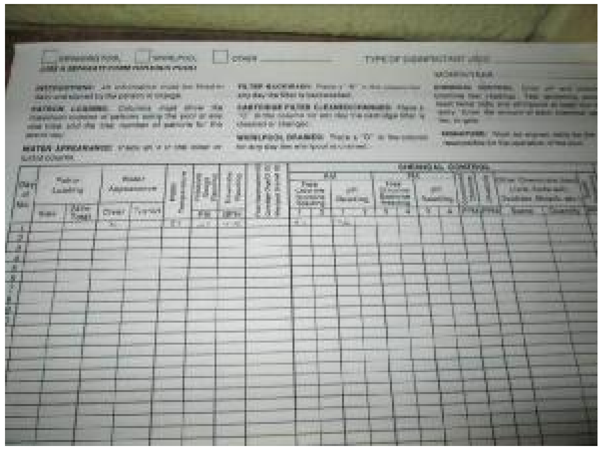

Image 106: Water Chemistry Logs

7. Chemical Controllers

Observations and Comments:

a) A Chemtrol 320 is used as the competition pool's water chemistry controller. At the time of the site inspection, the controller was in alarm mode as the pH and chlorine were out of range at 8.0 and 3.5 ppm+, respectively.

b) Since the chemical feed pumps were not set up to feed chemicals at the time of the inspection, the controller will only serve as to read chemistry, not actually feed chemicals into the pool system

c) The manual water chemistry readings taken were as follows: free chlorine – 6.5 ppm; combined chlorine – 0.0 ppm; total chlorine – 6.5 ppm; pH – 8.0; temperature – 82 degrees; total alkalinity – 320; and calcium hardness – 0. These readings result in a Langelier Saturation Index (LSI) of -2.55 which is corrosive or aggressive.

Recommendations:

a) The water chemistry controller is a little out-of-date with current models. However, the readings were in line with what was recorded manually, so the probes are in good working order. As long as the controller is hooked up to the chemical feed pumps and the feed pumps are operational and dosing chemicals, this water chemistry controller should be able to continue and function well.

b) The recorded LSI is well into corrosive or aggressive territory. It is recommended to maintain LSI readings between +0.3 to -0.3, with 0 being perfectly balanced. The pool essentially has more capacity to dissolve calcium carbonate which is present in to pool itself, grout, and other cementitious products. Agressive water will cause etching on these surfaces under these conditions.

c) With total alkalinity of 320 ppm, it certainly has helped in raising the pH. At these levels, the pH becomes very stubborn and difficult to adjust. Cloudy water may result at the levels measured due to suspended calcium carbonate in the pool water.

d) The pH should be maintained between 7.4 and 7.6, the chlorine between 1.0 and 3.0 ppm, calcium hardness levels between 200 and 400 ppm, and total alkalinity between 80 and 120 ppm. Calcium chloride should be used to raise calcium hardness levels. Muriatic acid or sodium bisulfate should be used to lower total alkalinity.

e) With the pool water being so aggressive, deposits would not ordinarily be expected. What is observed in the pool may or may not be lime. During the next scheduled pool drain, the finish should be acid washed and any deposits should be removed. Moving forward, proper LSI balance is recommended and should be maintained. The issue of deposits, whether lime or not, should be helped considerably unless they are actually in the domestic source water. If that is the case, then further tests would need to be done on the domestic water and sequestering agents, scrubbers, etc. would need to be considered to remove it before entering the pool system.

Image 107: Water Chemistry Controller Meters

Image 108: Water Chemistry Controller Alarms and Controls

Image 109: Water Chemistry Controller and Probes

Image 110: Water Chemistry Controller Wiring Connections

8. Make Up Water

Observations and Comments:

a) Domestic water is introduced directly into the surge tank. As a result of being near the corrosive surge tank, the fittings on the domestic water line are corroded.

b) There was no reported water loss by staff. However, as has been illustrated throughout this report, there are many structural cracks where pool water has penetrated. During the site inspection, the domestic water was filling in the surge tank (and the pool was empty so there was no splash-out, the filters were not being backwashed, and evaporation was at a minimum).

Recommendations:

a) A water meter, solely on the pool fill line, should be installed so that the water consumption of the pool system can be monitored. This will give a clear indication on how watertight the vessel is. Backwash volume can be subtracted and if requested, Counsilman-Hunsaker can provide expected losses due to evaporation and splash-out.


Image 111: Domestic Water to Pool System


Image 112: Domestic Water Coming into Surge Tank

F. OPINION OF PROBABLE COST

The following opinion of probable cost* addresses the items identified in this report needing repair, replacement or renovation. Counsilman-Hunsaker recommends that when prudent, the renovation tasks should be bundled to be more cost effective. This efficiency may result in an overall savings in the project cost. Please note that several of the items may either be dependent on another item and some may be more or less intensive based on testing results. In addition, a line item have been added for an approximate new construction cost that would be for a new pool which would include the shell, tile finish, filtration, pool piping, chemical treatment, pool deck and safety equipment, etc.

Item	Unit	Unit Cost	Quantity	Item Cost
Provide a completely new pool including pool mechanical and chemical treatment equipment	Lump Sum	$650,000	1	$650,000
Drain and refill pool	Gallon	$0.005	117000	$585
Remove underwater pool window	Lump Sum	$1,500	1	$1,500
Replace the competition pool perimeter tile and provide new waterproofing membrane	Square Foot	$24	3450	$82,800
Regrout pool	Square Foot	$8	4250	$34,000
Remediate areas in the pool where corrosion is evident and replace randomly missing pool tiles	Lump Sum	$2,400	1	$2,400
Provide a water-based fire extinguisher	Each	$200	1	$200
Provide new pipe hangers and supports	Lump Sum	$650	1	$650
Install an SVRS on the suction side of the recirculation pump	Each	$700	1	$700
Provide impact flow meter for backwash piping	Each	$240	1	$240
Provide vacuum and compound pressure gauges for the recirculation pumps	Each	$85	2	$170
Move and install two new safety rope anchors	Each	$300	2	$600
Provide a battery-powered handicap lift	Each	$5,500	1	$5,500
Provide "No Diving" signage with the international no diving symbol	Each	$60	5	$300
Provide vertical depth markings around the pool perimeter	Each	$60	14	$840
Provide new deck anchors (starting blocks, grab rails, stanchion posts, stair railing in deck)	Each	$3,750	22	$82,500
Provide new relocated diving board, stand, and concrete/tile pedestal	Lump Sum	$9,500	1	$9,500
Provide a new life hook and pole	Each	$150	1	$150
Camera scope the below grade cast iron piping to inspect condition	Lump Sum	$800	1	$800
Provide a new recirculation pump	Each	$4,500	1	$4,500
Provide a new hair and lint strainer and reducers on both sides of the pump	Lump Sum	$2,800	1	$2,800
Provide new filter sand media	Each	$425	4	$1,700
Furnish new Triton high rate sand filters	Lump Sum	$6,000	1	$6,000
Provide a new check valve	Each	$1,750	1	$1,750
Seal surge tank and vent to exterior	Lump Sum	$2,750	1	$2,750
Acid wash the pool shell	Lump Sum	$2,000	1	$2,000

Provide a water meter on the domestic water line with totalizer and readout	Each	$2,400	1	$2,400
Provide secondary containment for pool chemicals	Lump Sum	$1,800	1	$1,800
Provide chemical hazard signage	Each	$40	2	$80
Furnish a medium pressure UV system	Each	$49,000	1	$49,000

*The engineer has no control over the cost of labor, materials, equipment, or over the contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to the engineer at this time and represent only the engineer's judgment as a design professional familiar with the construction industry. The engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.