Mount Vernon
IOWA



Dear Honorary Mayor Moore and Honorary Council Members,

Attached you will find that Geophysical Exploration Report from Terracon and a Structural Investigation from V&K Engineering. No significant voids were discovered that would be of major concern. We are still waiting for one more test to be completed as indicated in the V&K report.

We can discuss the reports at Council Meeting on Nov 16th.

Respectfully submitted,

Matt Siders
Zoning Administrator

November 6, 2015

City of Mt. Vernon
201 7th Street NE
Mt. Vernon, IA 52314

Attn: Mr. Matt Siders
P: (319) 895-9513
E: msiders@cityofmtvernon-ia.gov

Re: Geophysical Exploration Report
Mt. Vernon Pool – GPR Services
919 2nd Avenue North
Mt. Vernon, Iowa
Terracon Project No. 06153521

Dear Mr. Siders:

On October 29, 2015 a representative of Terracon Consultants, Inc. (Terracon) performed geophysical exploration services at the referenced site.

## 1.0 PROJECT DESCRIPTION

We understood that a non-destructive survey was requested to identify the presence and location of voids and undermining as well as specific structural information at the public pool in Mt. Vernon, Iowa. The survey was performed on the pool walls, floor, and select portions of the surrounding pool deck as instructed by Larry Spellerberg with Veenstra & Kimm, Inc. Mr. Spellerberg arrived on-site prior to our arrival, and did his own investigation of the area. Terracon used ground penetrating radar (GPR) in the areas that he had identified, as well as other areas that he requested further information.

## 2.0 EXPLORATION METHODS

Terracon used a GPR system consisting of a hand-cart mounted 1600 MHz antenna made by Geophysical Survey Systems, Inc. (GSSI) to perform an upper profile geophysical survey. In general, field data collection follows procedures referenced in ASTM D 6432 Standard. More information on both the general method and collection procedures can be found in this standard as well as the attached Appendix A.

A free-scanning technique was used to scan the floor slab of the pool and the surrounding pool deck as well as the pool walls. This technique involved analyzing the data in the field so that results can be supplied in real-time, without using software to post-process.

## 3.0 FINDINGS AND CONCLUSIONS

Terracon scanned the entire concrete floor of the pool on an approximate five (5) foot spacing. Line scans were analyzed in the east-west direction approximately every 5 feet on-center. Scanning was also performed on the surrounding pool deck from the pool out to approximately 5 feet. 9 locations within the pool were investigated to determine reinforcing steel spacing, depth, and approximate slab thickness.

The various anomalies that were encountered during the scan as well as the locations of the 9 areas scanned for structural information are shown in the attached Exhibit 1. The structural information is provided in the tables below.

**Table 1: Pool Floor**

| Location | Description | Horizontal Bar Spacing (north-south) (in) | Vertical Bar Spacing (east-west) (in) | Approximate Bar Depth (in) | Approximate Slab Thickness (in) | Other Comments |
|---|---|---|---|---|---|---|
| 1 | New Floor | 12 | 12 | 3 | 5-6 | |
| 2 | New Floor | 12 | 12 | 4-5 | 6 | |
| 3 | Old Floor | 12 | 12 | 6 | 10 | |
| 4 | Old Floor | 12 | 12 | 4-5 | 10 | |

**Table 2: Pool Walls**

| Location | Description | Horizontal Bar Spacing (north-south) (in) | Vertical Bar Spacing (east-west) (in) | Approximate Bar Depth (in) | Approximate Slab Thickness (in) | Other Comments |
|---|---|---|---|---|---|---|
| 5 | Old Wall | 8 | 12 | 2 and 9 | 12 | 2 mats of bar in concrete below drain |
| 6 | Old Wall | 10 | 12 | 2 and 9 | 12 | 2 mats of bar in concrete below drain |
| 7 | Old Wall | 8-9 | 12 | 2 and 9 | 12 | 2 mats of bar in concrete below drain |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | New Wall | 20 | 12 | 3 | 12+ | Only inside bar detected, but back side of wall not encountered. In bottom 1' of wall, bar encountered every 6" on-center |
| 9 | New Wall | 12 | 20 | 3 | 12+ | Only inside bar detected, but back side of wall not encountered. In bottom 1' of wall, bar encountered every 6-10" on-center. Reinforcing not consistent in this area. |

Locations of anomalies observed in the field are presented in the attached Exhibit. Two probable drains were encountered in the older portion of the pool. A utility was also detected that appeared to feed into the mushroom-shaped piece in the new portion of the pool. Anomalies consistent with voids were encountered around most of the pool deck out to 2-3 feet away from the pool. Small holes were drilled in two locations and small 1-2 inch voids were encountered. The holes were patched with an epoxy before leaving the site.

## 4.0 LIMITATIONS

It should be noted the process relies on instrument signals to indicate physical conditions in the field. Signal information can be affected by on-site conditions beyond the control of the operator, such as, but not limited to, cultural features, concrete/soil types, concrete/soil moisture, groundwater table depth, and/or reinforcing steel spacing. Interpretation of those signals is based on a combination of known factors combined with the experience of the operator and geophysical scientist evaluating the results. Utilizing conventional observation, sampling, and testing of select areas are recommended to confirm the results from the geophysical surveys. As with all geophysical methods, the geophysical results provide a level of confidence, but should not be considered absolute. We cannot be responsible for the misinterpretation of unverified geophysical results by others.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geophysical practices. No warranties, either express or implied, are intended or made.

The results presented in this report are based upon the data obtained from the geophysical surveys and from other information discussed in this report. This report does not reflect variations that may occur in areas inaccessible to the geophysical equipment, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction.

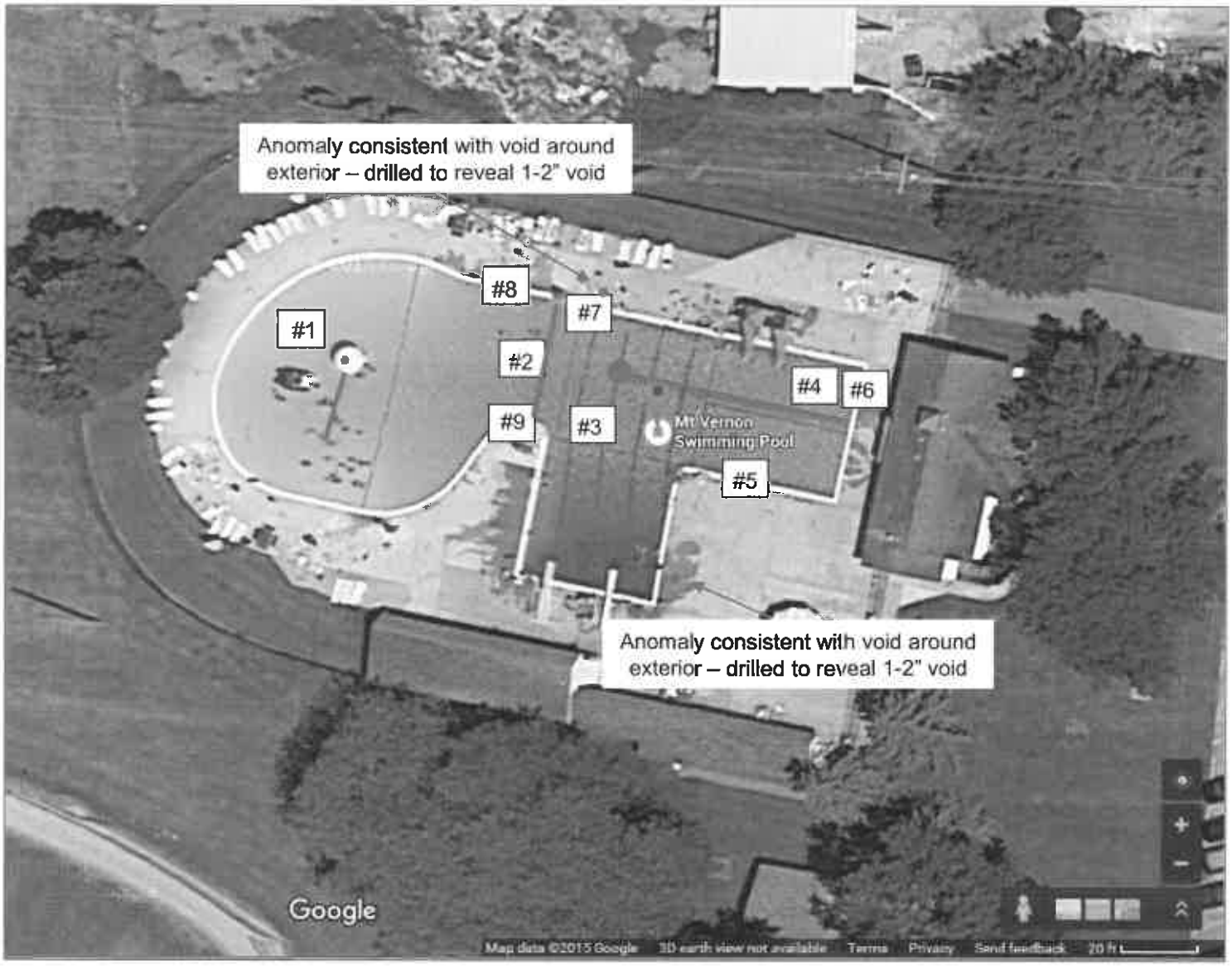
We appreciate the opportunity to work with you on this project. Please do not hesitate to contact the undersigned if you have any questions regarding this information or if we can be of further service to you.

Sincerely,
**Terracon Consultants, Inc.**

Rob Kramer
Geophysicist

Tom Lisi, P.E., CWI
Senior Project Engineer

Attachment: Exhibits 1: Anomaly Location Diagram
Appendix A: Ground Penetrating Radar Operation




| | |
|---|---|
| # | LOCATION CHECKED FOR STRUCTURAL INFORMATION |
| | ANOMALIES CONSISTENT WITH DRAINS/UTILITIES |
| | ANOMALIES CONSISTENT WITH VOIDS |

| | | | |
|---|---|---|---|
| Project Manager: RAK | Project No. 06153521 | Terracon Consulting Engineers & Scientists | GROUND PENETRATING RADAR |
| Drawn by: RAK | Scale: N.T.S. | 2640 12th St SW, Cedar Rapids, Iowa 52404 | Mt. Vernon Public Pool |
| Checked by: TPL | File Name: | PH. (319) 366-8321 FAX. (319) 366-0032 | 919 2nd Ave N. |
| Approved by: TPL | Date: NOV 2015 | | MT VERNON, IOWA |

EXHIBIT 1

# Appendix A: Ground Penetrating Radar Operation

GPR utilizes radio waves to detect changes in the subsurface of the area being scanned. Changes in the signal generally indicate material property changes such as, but not limited to, electromagnetic conductivity and dielectric constant, which in some cases can be qualitatively linked to other material properties such as density, moisture, or material type, and can be effective in identifying the presence and location of items such as voids, buried concrete, tanks, underground utilities, and embedded reinforcing steel in concrete and masonry structures, among other things. The instrument is capable of both producing real-time images and recording images for later interpretation.

It should be noted that these processes rely on instrument signals to indicate physical conditions in the field. Signal information can be affected by on-site conditions beyond the control of the operator such as, but not limited to: ground surface cover, concrete/soil types, concrete/soil moisture, and/or reinforcing steel spacing. Interpretation of those signals is based on a combination of known factors combined with the experience of the operator and geophysical scientist evaluating the results. Utilizing conventional observation, sampling and testing ("truthing") of select areas is highly recommended to confirm the results from the geophysical surveys. As with all geophysical methods, the geophysical results provide a level of confidence but should not be considered absolute. Thus, we cannot be responsible for the interpretation of geophysical results by others.

GPR antennas are available in varying frequencies. Care should be taken to select antenna that will best meet the project needs. Lower frequency antennas can penetrate deeper, but have a lower resolution. Conversely, the higher the frequency the better the resolution with shallower penetration. The following table briefly outlines the typical penetration and uses for each antenna.

| Appropriate Application | Primary Antenna Choice | Secondary Antenna Choice | Depth Range (Approximate) |
|---|---|---|---|
| Structural Concrete, Roadways, Bridge Decks | 2600 MHz | 1600 MHz | 0-0.3 m (0-1.0 ft) |
| Structural Concrete, Roadways, Bridge Decks | 1600 MHz | 1000 MHz | 0-0.45 m (0-1.5 ft) |
| Structural Concrete, Roadways, Bridge Decks | 1000 MHz | 900 MHz | 0-0.6 m (0-2.0 ft) |
| Concrete, Shallow Soils, Archaeology | 900 MHz | 400 MHz | 0-1 m (0-3 ft) |
| Shallow Geology, Utilities, UST's, Archaeology | 400 MHz | 270 MHz | 0-4 m (0-12 ft) |
| Geology, Environmental, Utility, Archaeology | 270 MHz | 200 MHz | 0-5.5 m (0-18 ft) |
| Geology, Environmental, Utility, Archaeology | 200 MHz | 100 MHz | 0-9 m (0-30 ft) |
| Geologic Profiling | 100 MHz | MLF (16-80 MHz) | 0-30 m (0-90 ft) |
| Geologic Profiling | MLF (16-80 MHz) | None | Greater than 30 m (90 ft) |

Table from Geophysical Survey Systems, Inc.

November 11, 2015

Matt Siders
Director of Parks and Recreation/Zoning Administrator
City of Mount Vernon
201 7th Street NE
Mount Vernon, IA 52314

MOUNT VERNON POOL STRUCTURAL INVESTIGATION
LETTER REPORT

On October 29, 2015 Veenstra and Kimm, Inc. (V&K) completed an on-site investigation of the City's swimming pool. The purpose of the investigation was to visually observe the readily accessible portions of the pool's floor and walls to identify the cause and location of excessive leakage. On the same day a separate related geophysical exploration was conducted by Terracon and the results of their exploration was reported in their Geophysical Exploration Report dated November 6, 2015. This letter report with attached photos is a summary of V&K's observations.

As reported by Mr. Nick Nissen on the date of our site visit, the original pool was constructed in the 1960s with an addition being constructed at the west end of the pool at a later date. Photo 1 is a view the pool from the west. As part of our investigation, the floor and walls of the pool were observed to identify visible cracks where leaking could occur. Photo 2 shows typical cracks that were observed in the floor of the pool. Approximately 265 lineal feet of crack were identified in the floor of the original pool. No cracks were observed in the floor of the more recently constructed addition.

The walls of the pool had relatively few cracks, but the masonry grout at the top of the trough wall was deteriorated where the plastic cover was added. The deteriorated grout is shown in Photo 3. It should be noted that the deteriorated grout would not allow leakage from the pool. At one location along the north wall the plastic cover was

removed to allow observation of a crack in the trough wall that had been repaired. The plastic cover was not removed at any other locations so the majority of the trough was not observed.

In addition to our visual observation, the floor and walls were sounded with a chain and/or hammer to identify hollow sounding areas. Hollow sounds can indicate either a void below or behind the floor/wall or delamination of the concrete. Voids can occur where the underlying soil has settled and this can occur at leaking areas where water can erode the soil. Delamination occurs where expansive force created by corroded steel reinforcement in the concrete causes the exterior surface of the concrete above the reinforcement to break free. The results of the sounding indicated approximately 40 square feet of hollow area exists below the floor and approximately 2 square feet behind the wall. Ground penetration radar (GPR) was used by Terracon to verify the approximate location, size, and depth of the voids/delaminations. Probe holes were also drilled in the deck slab at two locations behind the walls (See Photo 4 for typical probe hole). The results from the sounding, GPR and probe holes did not identify void locations that we could conclude to be the results of leakage.

With the exception of one void below the floor in the deep end of the pool that is approximately 10 square feet in area, the size of the individual voids were not substantial. GPR used at this location was not capable of determining the depth of the void and a sufficient drill bit length was not available to drill a probe hole. It is our understanding that Terracon will drill and probe this location in the future so the depth of the void can be determined.

GPR was also used to determine the approximate location of the steel reinforcement in the floor and walls of the pool and the thickness of the floor and walls. While we could not determine the size of the reinforcement bars, the spacing and floor/wall thicknesses indicate that the design of the floor and walls have sufficient structural capacity.

At the time of the site visit Mr. Nissen indicated that when the pool is empty infiltration of exterior water is observed in the manhole where the below floor piping returns water to the filter building. Mr. Nissen suggested, and we agree, that this could be a location where water is leaking from the pool. The manhole was determined to be a confined space area so the bottom and walls of the manhole were not observed during our site

visit.

**RECOMMENDATIONS:**

The overall structural condition of the concrete walls and floor of the pool appeared to be satisfactory. It is our opinion that with proper maintenance the pool can continue to function properly if the cause of leakage is identified and corrected. No determination has been made to the cause of the leakage based on the level of investigation that has been performed to date. It is our opinion that the following items could help determine the cause of the leakage from the pool:

Drill and probe the hollow area below the floor of the deep end of the pool to determine the depth of the void below the floor.

Remove the remainder of the plastic cap at the trough to see if unrepaired cracks exist in the trough.

Observe the manhole where piping enters the filter room to determine if cracks or voids in the manhole are allowing leakage. Proper confined space equipment and procedures must be used.

Mr. Nissen indicated that the cracks in the floor of the pool are repaired at an approximate 5 year interval. The method used for the past repairs should be investigated to determine if a surface caulk or pressure installed epoxy injection was used to repair the cracks. Pressure installed epoxy would be more effective than a surface applied caulk. Depending on the method used for repair, further investigation may be needed to approximate the amount of leakage through the cracks.

The ground penetration radar identified what could be an abandoned pipe that runs east/west below the 4 to 5 foot deep section of the original pool. We recommend that the City contact Charles Halsey or other past workers at the pool to see if they know if a drain pipe or other utility exists at this location. A leaking abandoned pipe could allow/increase leakage if there is a path for water to reach the pipe.

If you have any questions or comments concerning this report, please contact the writer

at 515-225-8000.

VEENSTRA & KIMM, INC.

Lawrence J. Spellerberg, P.E.

LJS:dml
5131-029
Enclosures

Photo 1 Looking East at Swimming Pool

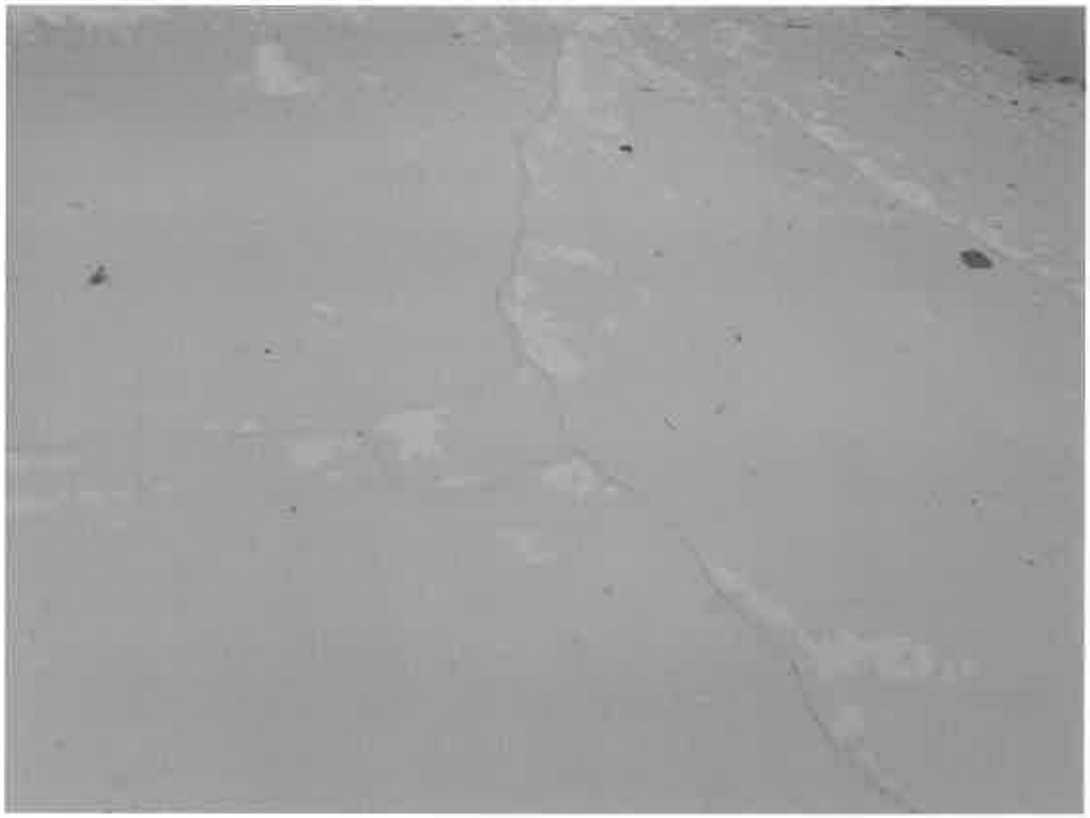


Photo 2 Typical Cracks in Floor

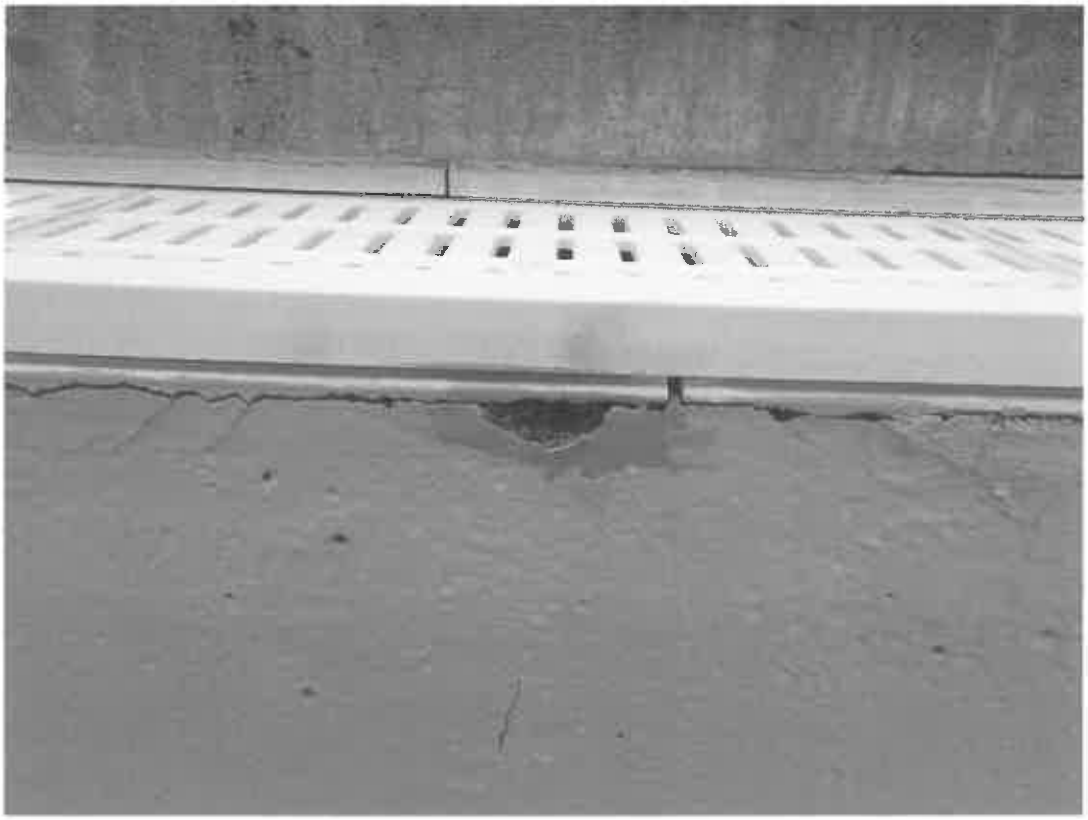


Photo 3 Deteriorated Grout at Trough Below Plastic Cover

Photo 4 Probe Hole in Deck Behind Wall

| Priority | Item | Cost | Running Total |
|---|---|---|---|
| | | | |
| 1 | Concrete Work / Patch Basin | $10,000 | 10,000 |
| 1 | New Zero Deck Pump | $7,000 | 17,000 |
| 1 | New Controllers and Probes | $7,000 | 24,000 |
| 1 | Roto Rooter - Televise pipes below deck | $5,000 | 29,000 |
| 1 | LED Lighting exterior of pool house and bath house | $2,000 | 31,000 |
| 1 | Create Storage Closet in Bath House | $1,000 | 32,000 |
| 1 | New locks installed | $1,000 | 33,000 |
| 1 | Paint Pool Basin and Deck | $1,000 | 34,000 |
| 1 | Replace Two Old Fliters (2 Dual Cell Filters, Piping, Flow Meter, Valves) | $80,000 | 114,000 |
| 1 | New Plumbing ...all encompassing bath house and pool house | $20,000 | 134,000 |
| 1 | New Deep End Pump | $15,000 | 149,000 |
| 1 | Permits / Design | $10,000 | 159,000 |
| 1 | Remove tile flooring and replace with stained concrete | $8,000 | 167,000 |
| 1 | LED Lighting in Filter Room, new wiring in Bath House/Fliter Room | $2,500 | 169,500 |
| 1 | New Security Lights and wiring | $2,000 | 171,500 |
| 1 | New Water Heater for pool house/ concessions | $1,000 | 172,500 |
| 1 | Motion Sensors and Door Alarms for security | $1,000 | 173,500 |
| 2 | Gas Heater for Pool | $27,000 | 200,500 |
| 2 | Solar Blanket | $3,000 | 203,500 |
| 2 | Paint ceiling in shower rooms | $1,000 | 204,500 |
| 3 | New Feature (i.e..Corkscrew Slide (10.7 ft high and 19 ft length) | $20,000 | 224,500 |
| 3 | Replace lockers with new lockers | $5,000 | 229,500 |
| 3 | Large Umbrella for Shade | $5,000 | 234,500 |
| 3 | Extension of Concession Stand to east/ Block Walls | $5,000 | 239,500 |
| 3 | Soffit and Fascia on Pool House | $1,000 | 240,500 |
| 3 | Paint interior of bath house | $1,000 | 241,500 |
| X | Contigency | $24,150 | 265,650 |

Priority (1-3)

1= Most Critical

3 = Least Critical

**Projects already completed FY 2016 (this fiscal year)**