November 14, 2024

Oaks HOA
Palmyra, Pennsylvania
info@palmyraoaks.com

Re: Site Assessment/Observations – The Oaks Residential Development
Palmyra, Lebanon County, Pennsylvania
ALW Project No. 2024-09B

Dear Oaks HOA Board,

As authorized by The Oaks HOA (Client), the ALW Group, LLC (ALW) visited the above residential development located in Palmyra, PA on November 1, 2024. The purpose of the meeting was to review available site/land development plans and observe conditions associated with the storm water management conveyance throughout the development. Prior to the site reconnaissance, we discussed the history of the HOA and past surface depressions/sinkholes.

This document has been prepared to outline some of the significant findings, observations, and background associated with the housing development, stormwater management (SWM) facilities throughout the footprint of the Oaks development, with particularly focus on the condition of existing site features and the conveyance of stormwater. Further, it is our understanding that this document will be utilized to provide guidance as it relates to future and/or ongoing maintenance activities within the Oaks development.

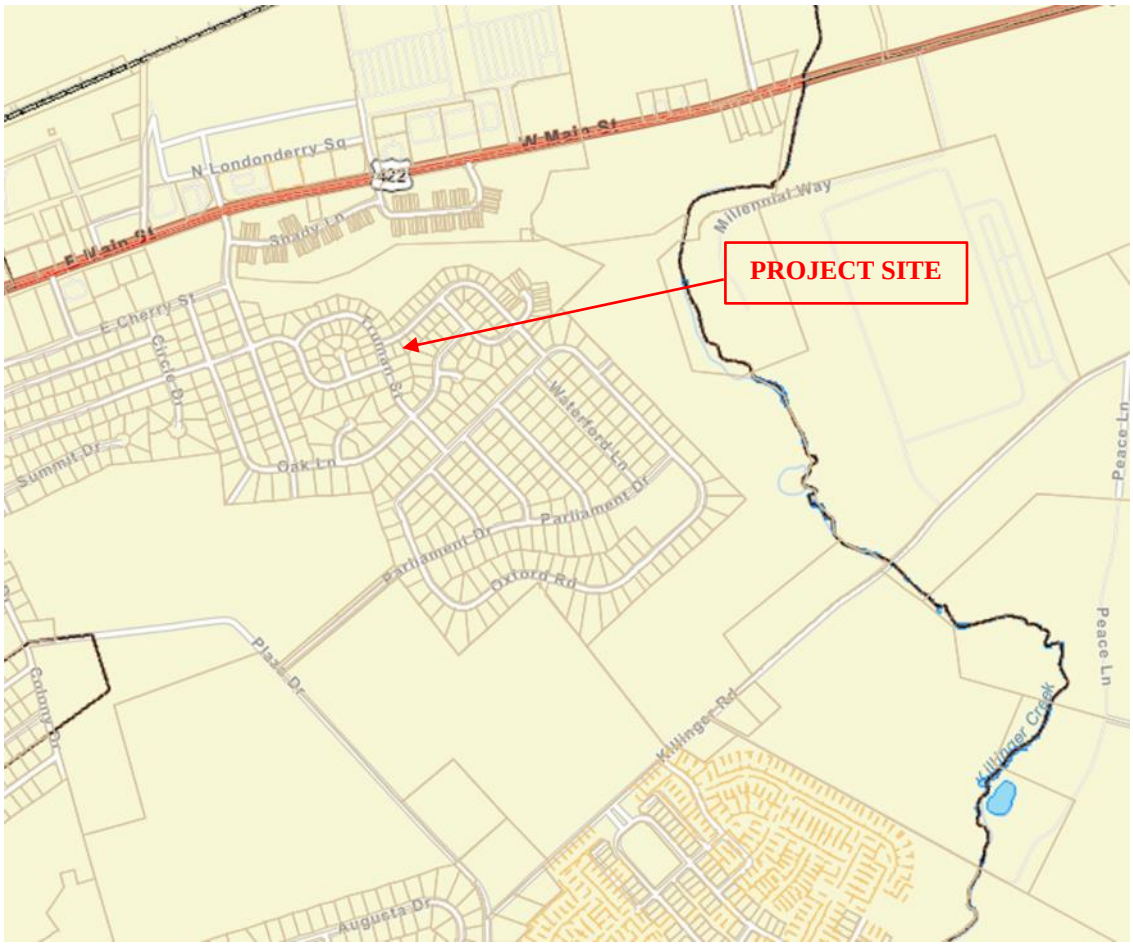
Project Location/Description

The Oaks residential development is situated in the Palmyra area of Lebanon County, Pennsylvania. There are approximately 150+ residential dwellings comprising The Oaks. Specifically, the development is situated in North Londonderry Township, along the southern side of Route 422. See **Figure 1** below.

The residential development primarily consists of multi-story residences bordered and bisected by numerous paved streets. Municipal sewer and water services are provided to the development along with SWM facilities. SWM inlets are placed throughout the streets and within several swale/green areas between houses.

The entire development is bound to the north by SWM basins, trees and green space. In general, surface water drainage and stormwater runoff flows from areas of high to low (south to north).

FIGURE 1 – SITE LOCATION PLAN



NOTES: Figure 1 modified from open street maps via © 2024 Microsoft

Background Information

As provided by the HOA, ALW reviewed *Preliminary Plans* for the Oaks development entitled Phase Four. The plans were prepared by H. Edward Black & Associates, PC and dated July 1995. The plan set was noted to be incomplete; however, grading and utility plans depict the location of subsurface utilities and SWM alignments.

As stated earlier, stormwater inlets and swales serve to collect runoff throughout various points of the development. Stormwater is generally directed/discharged to three SWM basin (labeled on the aforementioned plans as SWM Basin #1 through #3). Based on a review of the drawings, each basin is equipped with an emergency spillway and an outflow pipe. Although not specifically noted, each basin appears to have been constructed as detention with excess storm runoff carried to a drainage easement further to the north.

Through discussion with various members of the HOA board of directors, there does not appear to be an extensive history of sinkhole development or similar activity at the Oaks. A recent SWM pipe repair and several closed depressions were restored earlier in 2024. Although there is not much in the way of details, reportedly the northern berm associated with SWM Basin #1 was reconstructed some time after the Oaks was completed. According to information provided, there was apparent instability along the slope forming the northern embankment. The embankment was restored and reinforced. No further issues/concerns have been reported.

Site Geology/Sinkhole Activity

ALW has reviewed the Pennsylvania Department of Conservation and Natural Resources (PA DCNR) mapping website referred to as PaGEODE. Review of PaGEODE indicates that the project site and the AOC are underlain by the Epler Formation (Ordovician Age). The Epler Formation consists of very finely crystalline, medium-gray limestone interbedded with gray dolomite. It also contains coarsely crystalline lenses. Beds are thin to flaggy and moderately well bedded to well bedded. The unit is approximately 1,000 feet thick.

In addition to PaGEODE, ALW also reviewed mapping entitled *Sinkholes and Karst-Related Features of Lebanon and Dauphin Counties, Palmyra 7.5-Minute Series Quadrangle*, prepared by WE Kochanov and the USGS, dated 1988 and 1989 (Open File Report 8802). Based on our review of this mapping, numerous historic sinkholes and karst-related features have been mapped/documented throughout the area occupied by The Oaks development.

As stated in earlier paragraphs, karst activity (sinkholes, partial ground collapses) have occurred in the past at SWM Basin #2. Specifically, a damaged SWM outflow pipe concentrated water in and around this area causing a series of sinkhole type features over the years. The pipe and surrounding ground surfaces were repaired/restored earlier in 2024.

In addition, there are currently a series of open/active sinkholes just beyond (to the north) SWM Basin #1 situated near the northeast corner of the Oaks development. Additional discussion of this area is provided in later paragraphs of this summary report.

Site Reconnaissance/Significant Observations

ALW Licensed Professional Geologist, Scott Summers visited the site on November 1, 2024. The site reconnaissance was performed with a member of the HOA and included traversing common areas and spaces throughout the development, including roadways, green spaces, SWM basins and drainage easement. **Figure 2 – Site Features**, has been included as an attachment to assist in providing a location to accompany descriptions provided herein. In summary, our site visit revealed the following key observations and findings:

- The overall condition of paved streets and green areas was considered good. No significant areas of concern were noted with respect to pavement surfaces, green swales between houses, or inlet structures. Excess accumulation of leaves and grass clippings were noted in only a few of the sump inlets observed. We understand that the township is responsible for maintenance of roadways and periodic cleaning of inlets.

- The overall condition of SWM facilities, such as basin inflow pipes and structures, embankments, and emergency release components, was noted to be in good condition. No obvious concerns were noted with respect to the condition of basin bottoms or embankments. SWM facilities appear to be properly functioning.

- SWM Basin No. 1 was observed to be in good condition with no significant concerns/issues.

- SWM Basin No. 2 was observed to be in good condition with no significant concerns/issues.

- At SWM Basin #3, it was noted that a 36-inch CMP discharges into the basin from Apple Blossom Lane. The end piece of the concrete discharge pipe has settled and separated from the main pipe alignment (See Photograph No. 1). The end piece of pipe does not appear to be damaged and no erosion was obvious around or beneath the discharge pipe. Although the pipe does not currently appear to be significantly disruptive to water flow, the displaced piece of pipe may cause irregular flow of stormwater exiting the pipe into the basin, particularly during heavy storm events. This condition should be periodically monitored. Should erosion begin to occur around or beneath the end of the pipe, it may be necessary to reconnect or reattach the end section of the CMP.

- The underground SWM alignment discharging water into SWM Basin #3 from East Maple Street terminates at the basin just behind Lots 51 and 52. The pipe exits at an end wall (EW-2) on the south side of SWM Basin #3. At this location, there appears to have been rip-rap stone added

above the end wall. Please note, that the existing condition does not match the design plans, which likely indicates that rip-rap placement occurred after the basin was completed. It appears that the ground surface in this area may have been experiencing erosion at some point in the past. It also appears that the ground surface may have been graded in a way as to create a subtle swale between Lots 51 and 52 in the direction of the head wall.

At the time of our site visit, we observed that the end of the PVC pipe exiting the end wall is becoming separated. This separation has left a gap between the pipe and concrete end wall. Water exiting the pipe is flowing into the opening around the pipe causing undermining of the pipe. The PVC pipe is beginning to crack and degrade along the edges, most likely due to "freeze-thaw" conditions as a result of excess water ponding around the pipe. Portions of the concrete end wall are experiencing the same damage. It is likely that water is flowing through the rip-rap above the head wall and contributing to erosion around the pipe. See Photograph Nos 2 through 5. We recommend correction of the ground surface condition above the end wall. Further, the gap or separation between the concrete end wall and PVC pipe should be closed/sealed to prevent water intrusion into and beneath the structure.

□ There are currently a series of open/active sinkholes just beyond (to the north) SWM Basin #1 situated near the northeast corner of the Oaks development. The sinkholes can generally be grouped into three (3) features (See Photograph Nos. 6 and 7). These features are situated in a topographically low area just beyond the outflow pipe from SWM Basin #3. Bedrock outcrops were visible within the sidewalls of one or more of the features. It is likely that these features are "connected" in the subsurface. The open features are currently secured within orange safety fencing.

The open sinkholes are currently situated within the wooded drainage area just beyond the toe of the embankment for SWM Basin #3. No apparent concerns were noted during the site reconnaissance with respect to the embankment. We recommend periodic monitoring of these features and the adjacent ground surfaces to document that no significant ground loss is occurring over time throughout this area of the property. Restoration of these features may also be considered.

Recommendations/Budget Considerations

1. Although no immediate concern was noted at this time, SWM inlets and alignments should be properly maintained.

2. The 36-inch CMP discharge into SWM #3 may need eventual reattachment of the end section of pipe. Although not considered an immediate concern, should future erosion occur beneath or around the end of the pipe, it may be necessary to reconnect the CMP end section. The approximate costs of re-attaching this end section is anticipated to be less than $1,000.00.

3. The end wall (EW-2) at SWM #3 has a disconnected PVC discharge pipe. The separation between pipe and end wall should be sealed/closed/parged in the near future. We recommend closing/sealing any cracks in the end wall as well. Recommend these repairs be performed within approximately 1-2 year time frame. The approximate costs of these repairs are anticipated to be less than $5,000.00.

4. The rip-rap stone bed placed above the end wall should be eliminated since it is acting to collect and funnel water into the top of the end wall. Some re-grading will be needed in this area as well to convey water away from the top of the end wall. Stabilization of the ground surface should be performed to re-establish grass along the top of the embankment throughout this area. We recommend this work to be performed within a 1-2 year time frame. The approximate costs of these corrective measures are anticipated to be on the order of $5,000.00.

5. The active/open sinkholes beyond SWM Basin #1 should remain secure with safety fence since these features may represent a liability consideration. The condition of these openings should be periodically monitored to ensure no significant ground loss is occurring that may jeopardize other surrounding site features. Consideration could be given to closing these features. Estimated costs for closure of the existing sinkhole features are unknown at this time and will vary based on the approach, equipment and materials utilized. If requested, additional consultation can be performed to ascertain costs associated with practical and economical solutions to restoration of these features.

6. If desired or deemed beneficial to the HOA's planning/budgeting process, we would recommend an updated site assessment at approximately every 3 years, starting from the date of this initial document.

Closing

The information contained herein has been provided for the exclusive use of The Oaks HOA, their assigns, and attorneys. Use of this information by a third-party or other entity beyond those parties listed is strictly prohibited without the prior consent of ALW. Use of this information by unauthorized parties is done so, at their own risk and ALW can not be held responsible for such use.

Sinkhole development and the mitigation/remedial efforts associated with their restoration is extremely complicated. Further, there is no guarantee or warranty against sinkhole development, even after remedial efforts/activities. The opinions and recommendation presented herein have been provided according to accepted industry standards/practices within this geologic setting.

We appreciate the opportunity to be of assistance to you on this project. Should you have any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,

Scott A. Summers, PG
Commonwealth of Pennsylvania
Licensed Professional Geologist

Attachments: Site Photographs
Figure 2 – Site Features

SITE PHOTOGRAPHS

Photograph No. 1 – Separated end section of 36-inch CMP at SWM Basin #3

Photograph No. 2 – Photograph of end wall at SWM Basin #3 and rip-rap above concrete end wall.

Photograph No. 3 – Close up photograph of separation of pipe and concrete at EW-2.

Photograph No. 4 – Additional view of damaged PVC pipe exiting EW-2.

Photograph No. 5 – Additional view of end wall and discharge pipe at SWM Basin #3.

Photograph No. 6 – Safety fence surrounding sinkhole near SWM Basin #1.

Photograph No. 7 – View of sinkhole area beyond SWM Basin #1. Neighboring residences in background.

FIGURE 2 – SITE FEATURES