208 Church Street, SE
Leesburg, VA 20175
T: 703-777-3616
F: 703-777-3725

www.pennoni.com

M E M O R A N D U M

TO: Kimberley Fogle

FROM: Matt Lawrence, PE and BT Nivas, PE

DATE: 6/20/2016

SUBJECT: Mountain Shade – SWM Pond – Design & As-Built Plan Review

---

Pennoni reviewed the pond design and drainage report for the Mountain Shade Subdivision plan and have the following comments:

- The pond was designed such that portions of the runoff during the 10-year storm event will outfall through the emergency spillway. Per the Virginia Stormwater Management Handbook (VSMH), emergency spillways should be designed such that they are activated during the 100-year frequency storm and higher frequency storm events are conveyed through the principal spillway. {VSMH, First Edition, 1999, Volume 1, Page 3.03-4}
- Emergency spillway with grass lining was proposed in embankment fill. The crest elevation of the emergency spillway was approximately 5 ft to 7 ft. higher than the existing grade. An emergency spillway should be proposed in cut conditions, and armoring the spillway with rip-rap or concrete would be required if proposed within embankment fill. {VSMH, First Edition, 1999, Volume 1, Page 3.03-2}
- The 100-year pond routing calculations were not based on the assumption that the principal spillway is clogged, i.e. the spillway can discharge the entire 100-year flow. Hence the emergency spillway was designed for only 59.76 cfs, while the 100-year inflow into the pond is 172.68 cfs. It is good engineering practice that the emergency spillway is designed to convey the flows assuming the principal spillway gets clogged. {VSMH, First Edition, 1999, Volume 1, Page 3.03-1}
- The design plans specifies that the principal outlet structure as a standard DI-7 grate inlet on a standard pre-cast manhole. The dimensions of the manhole are not labeled on the plans. The pond pack design calculations indicate the weir length for the structure as 12 ft, which would imply that a 3 ft x 3ft square box was proposed.
- DI-7 grate is a flat top grate, which is not an acceptable trash rack as it is subject to clogging and does not have an anti-vortex device. {VSMH, First Edition, 1999, Volume 1, Page 3.02-22}

Pennoni reviewed the As-Built drawings and Report and have the following comments:

- No supporting computations were provided with the as-built plans to verify the as-built discharges and water surface elevations shown on the table on Sheet 2.
- The submitted As-Built Pond Report dated Nov 14, 2014 indicates incorrect crest length for the principal spillway structure. It shows 0 ft, while the design crest length is 12 ft. The as-built drawings to do not show the dimensions of the principal spillway structure.
- As-built plans indicate rip rap armoring was installed on the exit channel of the spillway, but not on the crest and side slopes of the spillway, all of which are in fill.
- Even though as-built submission had insufficient information, the review of the as-built plans and report indicates that it is in substantial conformance with the design intent. As-built data also indicates portions of the runoff during the 10-year storm will outfall

through emergency spillway as the design intended. The pond volume calculations based on design and as-built data, and a comparison of both is shown below.

MOUNTAIN SHADE SWM POND
POND VOLUME COMPUTATIONS - DESIGN DATA

Elevation	Area (sft)	A1+A2+SQR(A1*A2) (sft)	Depth (ft)	Incremental Volume	Total Volume (cft)	Volume Above Permenant Water Surface (cft)
632.00	592				0	
		3269	2.00	2179.52		
634.00	1680				2180	
		8060	2.00	5373.28		
636.00	3840				7553	
		15463	2.00	10308.82		
638.00	6592				17862	
		22706	1.30	9839.07		
639.30	8589				**27701**	0
		27364	0.70	6384.85		
640.00	9664				34086	6385
		33586	2.00	22390.68		
642.00	12800				56476	28776
		40729	1.00	13576.45		
643.00	14368				70053	42352

MOUNTAIN SHADE SWM POND
POND VOLUME COMPUTATIONS - AS-BUILT DATA

Elevation	Area (sft)	A1+A2+SQR(A1*A2) (sft)	Depth (ft)	Incremental Volume	Total Volume (cft)	Volume Above Permenant Water Surface (cft)
632.49	0				0	
		2014	1.51	1013.71		
634.00	2014				1014	
		10567	2.00	7044.50		
636.00	5289				8058	
		19830	2.00	13220.22		
638.00	8026				21278	
		25430	0.76	6442.22		
638.76	8935				**27721**	0
		29003	1.24	11987.92		
640.00	10419				39709	11988
		36935	2.00	24623.47		
642.00	14307				64332	36611
		48633	1.00	16211.14		
643.00	18193				80543	52823

MOUNTAIN SHADE SWM POND COMPARISON OF DESIGN VS AS-BUILT DATA			
	DESIGN DATA	**AS-BUILT DATA**	**NOTES**
BMP Elevation	639.30	638.76	BMP volume required per Design comps = 22,718 cft
BMP Volume (cft.)	27,701	27,721	
2-Yr. Elevation	641.18	640.55	Max Storage during the 2 yr storm per Design comps = 46,506 cft
2-Yr. Volume (cft.)	46,506	46,506	and corresponding WSE during as-built conditions is 640.55
10-Yr. Elevation	641.86	641.22	Max Storage during the 10 yr storm per Design comps = 54,686 cft
10-Yr. Volume (cft.)	54,686	54,686	and corresponding WSE during as-built conditions is 641.22
100-Yr. Elevation	642.49	641.88	Max Storage during the 100 yr storm per Design comps = 62,848 cft
100-Yr. Volume (cft.)	62,848	62,848	and corresponding WSE during as-built conditions is 641.88
Principal Spillway			
Culvert Size (in)	36" RCP	36" RCP	
Upstream Inv	633.50	633.21	
Downstream Inv	633.00	632.50	
Emergency Spillway			**100 yr WSE per Design Comps is routed elevation taken from the pond pack design computations. 100 yr WSE computed for As-Built condition is based on Weir Equation and assuming Principal Spillway is clogged. If Principal Spillway is assumed clogged, there is no freeboard available. The top of dam should be at 644.45 to provide 1 ft of freeboard when principal spillway is clogged.**
100-Yr. Discharge (cfs)	136.14	**172.68**	
Weir Length (ft.)	16.00	**15.00**	
Crest Elevation	641.50	**641.00**	
H (ft.)	0.99	**2.45**	
100-Yr. WSE	642.49	**643.45**	
Top of Dam	643.50	**643.10**	
Freeboard (ft.)	1.01	**(0.35)**	

The pictures provided show that the principal spillway is clogged. While it is not known how long the principal spillway was clogged, even the highest frequency storms would have activated the emergency spillway during the time the principal spillway was clogged. This also would lead to more discharge passing through the emergency spillway than for which it was designed. The larger discharges and inadequate armoring with rip-rap or some other erosion matting most likely caused the failure of the emergency spillway.