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October 26, 2016

Butler County Engineer's Office
1921 Fairgrove Ave
Hamilton, Ohio 45011-1965

ATTN: Teresa Barnes
Design Engineer

RE: Children's Hospital Expansion
As-built Detention Analysis

Ms. Barnes,

Please see the attached documents for verification that the expanded detention pond at the Children's Hospital Liberty Campus Inpatient Expansion site meets Butler County's requirements for water quality and detention.

As per the Detention Design Report submitted September 2013 and revised November 2013 the critical year storm is the 25-year storm and the allowable discharge for that storm event is 10.01 cfs. The as-built detention pond discharges 9.96 cfs during the 25-year storm event. The required water quality detention volume for the site is 1.74 acre-feet. The as-built detention pond provides this volume at 876.45'. The detention discharge control orifice is installed at 876.49'.

Please note that as a follow-up to our meeting on-site back in August, the contractor performed earthmoving operations in the bottom of the detention basin to form the micropool and forebays. This also resulted in the wetted area being less which was a concern of the County's. The contractor also cleaned out the existing micropool and cleaned out the reverse flow pipe. He also added an 18" concrete riser to the top of the outfall structure and placed a metal plate on the outfall window to allow water to back up in the 100-year event up to the elevation 880.01. The 25 year storm event backs up to the elevation of 879.38. Note that the lowest point that was surveyed by Kleingers on the dam of the detention basin is 880.25. Photos of these modifications have been attached to this letter as well as the revised calculations.

It is Kleingers' opinion that the detention basin as modified satisfies Butler County regulations and satisfies the Ohio EPA's post-construction stormwater quality requirements. Please advise us if there are any further concerns that the County has.

Sincerely,

THE KLEINGERS GROUP

David V. Wright, PE, LEED AP
Group Leader

cc: FILE



JOB #: 000000.000

Table of Contents

***** MASTER SUMMARY *****

Watershed..... Master Network Summary 1.01

***** POND VOLUMES *****

PROPOSED POND... Vol: Elev-Area 2.01

***** OUTLET STRUCTURES *****

Det Outlet no 6" Outlet Input Data 3.01

MASTER DESIGN STORM SUMMARY

Network Storm Collection: BUTLER

Return Event	Total Depth in	Rainfall Type	RNF ID	
-----	-----	-----	-----	-----
1	2.5000	Synthetic Curve	TypeII	24hr
2	2.9000	Synthetic Curve	TypeII	24hr
5	3.6000	Synthetic Curve	TypeII	24hr
10	4.1000	Synthetic Curve	TypeII	24hr
25	4.7000	Synthetic Curve	TypeII	24hr
50	5.2000	Synthetic Curve	TypeII	24hr
100	5.6000	Synthetic Curve	TypeII	24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
-----	-----	-----	-----	-----	-----	-----	-----	-----
BUILDING LOT POS AREA		1	2.665		12.0000	42.42		
BUILDING LOT POS AREA		2	3.315		12.0000	52.52		
BUILDING LOT POS AREA		5	4.488		12.0000	70.39		
BUILDING LOT POS AREA		10	5.344		12.0000	83.19		
BUILDING LOT POS AREA		25	6.385		12.0000	98.56		
BUILDING LOT POS AREA		50	7.261		12.0000	111.33		
BUILDING LOT POS AREA		100	7.967		12.0000	121.53		
PARKING LOT POST AREA		1	1.089		12.0500	15.05		
PARKING LOT POST AREA		2	1.313		12.0500	17.97		
PARKING LOT POST AREA		5	1.709		12.0500	23.04		
PARKING LOT POST AREA		10	1.994		12.0500	26.65		
PARKING LOT POST AREA		25	2.338		12.0500	30.95		
PARKING LOT POST AREA		50	2.625		12.0500	34.52		
PARKING LOT POST AREA		100	2.855		12.0500	37.37		

Name.... Watershed

File.... H:\2013\130037\Design\Storm Drainage\ASBUILT Detention Analysis\2016-10-05 As-bui

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
POST SITE	JCT	1	3.754		12.0000	56.87		
POST SITE	JCT	2	4.628		12.0000	69.83		
POST SITE	JCT	5	6.197		12.0000	92.66		
POST SITE	JCT	10	7.338		12.0000	109.00		
POST SITE	JCT	25	8.723		12.0000	128.57		
POST SITE	JCT	50	9.886		12.0000	144.84		
POST SITE	JCT	100	10.822		12.0000	157.82		
*PROPOSED OUTFALL	JCT	1	3.753		12.5500	6.63		
*PROPOSED OUTFALL	JCT	2	4.628		12.6000	7.36		
*PROPOSED OUTFALL	JCT	5	6.196		12.6500	8.48		
*PROPOSED OUTFALL	JCT	10	7.337		12.7000	9.19		
*PROPOSED OUTFALL	JCT	25	8.722		12.8000	9.96		
*PROPOSED OUTFALL	JCT	50	9.886		12.8500	10.56		
*PROPOSED OUTFALL	JCT	100	10.821		12.9000	11.01		
PROPOSED PONDIN	POND	1	3.754		12.0000	56.87		
PROPOSED PONDIN	POND	2	4.628		12.0000	69.83		
PROPOSED PONDIN	POND	5	6.197		12.0000	92.66		
PROPOSED PONDIN	POND	10	7.338		12.0000	109.00		
PROPOSED PONDIN	POND	25	8.723		12.0000	128.57		
PROPOSED PONDIN	POND	50	9.886		12.0000	144.84		
PROPOSED PONDIN	POND	100	10.822		12.0000	157.82		
PROPOSED PONDOUT	POND	1	3.754		12.5500	6.63	877.76	1.834
PROPOSED PONDOUT	POND	2	4.628		12.6000	7.36	878.06	2.319
PROPOSED PONDOUT	POND	5	6.196		12.6500	8.48	878.58	3.205
PROPOSED PONDOUT	POND	10	7.337		12.7000	9.19	878.94	3.861
PROPOSED PONDOUT	POND	25	8.722		12.8000	9.96	879.38	4.667
PROPOSED PONDOUT	POND	50	9.886		12.8500	10.56	879.73	5.351
PROPOSED PONDOUT	POND	100	10.821		12.9000	11.01	880.01	5.905

Type.... Vol: Elev-Area
Name.... PROPOSED POND

Page 2.01

File.... H:\2013\130037\Design\Storm Drainage\ASBUILT Detention Analysis\2016-10-05 As-bui

Elevation (ft)	Planimeter (sq.in)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume Sum (ac-ft)
876.49	-----	1.2600	.0000	.000	.000
877.00	-----	1.4180	4.0147	.683	.683
878.00	-----	1.6540	4.6035	1.534	2.217
879.00	-----	1.8400	5.2385	1.746	3.963
880.00	-----	2.0230	5.7923	1.931	5.894
881.00	-----	2.2170	6.3578	2.119	8.013
882.00	-----	2.3450	6.8421	2.281	10.294

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
 Area1,Area2 = Areas computed for EL1, EL2, respectively
 Volume = Incremental volume between EL1 and EL2

Type.... Outlet Input Data
Name.... Det Outlet no 6"

File.... H:\2013\130037\Design\Storm Drainage\ASBUILT Detention Analysis\2016-10-05 As-bui

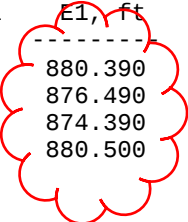
REQUESTED POND WS ELEVATIONS:

Min. Elev.= 876.31 ft
Increment = .10 ft
Max. Elev.= 882.00 ft

OUTLET CONNECTIVITY

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
-----	---		----	-----	-----
Inlet Box	R0	--->	03	880.390	882.000
Orifice-Area	00	--->	03	876.490	882.000
Orifice-Circular	03	--->	TW	874.390	882.000
Weir-Rectangular	W0	--->	TW	880.500	882.000
TW SETUP, DS Channel					



Type.... Outlet Input Data
Name.... Det Outlet no 6"

File.... H:\2013\130037\Design\Storm Drainage\ASBUILT Detention Analysis\2016-10-05 As-bui

OUTLET STRUCTURE INPUT DATA

Structure ID = R0
Structure Type = Inlet Box

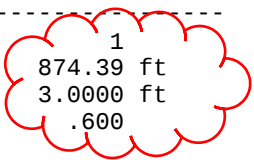
of Openings = 1
Invert Elev. = 880.39 ft
Orifice Area = 2.5000 sq.ft
Orifice Coeff. = .610
Weir Length = 6.50 ft
Weir Coeff. = 3.650
K, Reverse = 1.000
Mannings n = .0000
Kev,Charged Riser = .000
Weir Submergence = No

Structure ID = 00
Structure Type = Orifice-Area

of Openings = 1
Invert Elev. = 876.49 ft
Area = 1.2200 sq.ft
Top of Orifice = 877.57 ft
Datum Elev. = 876.49 ft
Orifice Coeff. = .600

Structure ID = 03
Structure Type = Orifice-Circular

of Openings = 1
Invert Elev. = 874.39 ft
Diameter = 3.0000 ft
Orifice Coeff. = .600



Type.... Outlet Input Data
Name.... Det Outlet no 6"

Page 3.03

File.... H:\2013\130037\Design\Storm Drainage\ASBUILT Detention Analysis\2016-10-05 As-bui

OUTLET STRUCTURE INPUT DATA

Structure ID = W0
Structure Type = Weir-Rectangular

of Openings = 1
Crest Elev. = 880.50 ft
Weir Length = 120.00 ft
Weir Coeff. = 3.200000

Weir TW effects (Use adjustment equation)

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

Index of Starting Page Numbers for ID Names

----- D -----
Det Outlet no 6"... 3.01

----- P -----
PROPOSED POND... 2.01

----- W -----
Watershed... 1.01

WATER QUALITY VOLUME

THE KLEINGERS GROUP

PROJECT Children's Hospital

Method 1

RUNOFF COEFFICIENTS

$$WQv = C * P * A / 12$$

$$C = 0.80$$

$$P = 0.75 \text{ IN}$$

$$A = 29 \text{ ACRES} *$$

$$WQv = 1.45 \text{ AC FT}$$

C = 0.8 INDUSTRIAL & COMMERCIAL
 C = 0.5 HIGH DENSITY RESIDENTIAL (>8/ACRE)
 C = 0.4 MED. DENSITY RESIDENTIAL (<8/ACRE)
 C = 0.3 LOW DENSITY RESIDENTIAL (<4 /ACRE)
 C = 0.2 OPEN SPACE AND RECREATION

P = Precipitation Depth of 0.75 - inches

*AREA TO INCLUDE OFFSITE DRAINAGE

JOB # 130037.003

DATE 3/23/2016

DESIGN CJG

CHECK DVW

= INPUT FIELDS

Method 2

RUNOFF COEFFICIENT

$$WQv = C * P * A / 12$$

$$C = 0.89$$

$$P = 0.75 \text{ IN}$$

$$A = 26.62 \text{ ACRES} *$$

$$WQv = 1.48 \text{ AC FT}$$

$$C = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$$

WHERE: i = IMPERVIOUS RATIO

IMPERVIOUS RATIO, i = IMPER. AREA / TOTAL AREA

IMPERVIOUS AREA = 10.36

TOTAL AREA = 10.36

i = 1.00

P = Precipitation Depth of 0.75 - inches

*AREA TO INCLUDE OFFSITE DRAINAGE

Req. WQv= 1.45 AC FT Dry EDv= 1.74 AC FT Wet EDv= 1.09 AC FT

Basin Type= DRY Required EDv outside detention or wet pool = 1.74 AC FT <--- Required Volume

BASIN STORAGE VOLUME

IF ALL ELEVATIONS NOT RQD, REPEAT TOP OF BASIN INFO

Conical Method Vol = (1/3) * (EL2-EL1) * (AREA1+ AREA2+ SQRT(AREA1 * AREA2))

ELEV.	SQ FT	ACRE	AVG	DELTA	VOL	CUM VOL	ELEV	REQ VOL
882	102152	2.345			2.281	9.952	882	
			2.28	1				878.40
881	96593	2.217			2.120	7.860	881	
			2.12	1				
880	88127	2.023			1.931	7.671	880	
			1.93	1				876.93
879	80150	1.840			1.746	5.740	879	
			1.75	1				876.71
878	72034	1.654			1.534	3.994	878	
			1.53	1				876.53
877	61758	1.418			1.303	2.460	877	
			1.30	1				876.45
876	51904	1.192			1.015	1.157	876	
			1.01	1				876.57
875	36940	0.848			0.142	0.142	875	
			0.28	0.5				880.62
874.5	1	0.000				0		

13.54

REQUIRED STORAGE AVAILABLE AT: 876.45 *DEPTH = 1.95 FT <--- Elevation Volume Provided

SIZE ORIFICE FOR EXTENDED DETENTION VOLUME DRAIN

*** DOUBLE CHECK UNITS ***

METHOD 2: $Q(\text{avg}) = EDv / T_d$

$$EDv = 1.74 \text{ AC FT}$$

$$T_d = 48 \text{ HOURS}$$

(48 hours for dry/24 for wet)

$$Q(\text{avg}) = 0.4386 \text{ CFS}$$

$$H(\text{avg}) = H(\text{max}) / 2$$

$$H(\text{max}) = 1.95 \text{ FEET}$$

$$H(\text{avg}) = 0.9737 \text{ FEET}$$

$$A = Q(\text{avg}) / C * (2 * g * H(\text{avg}))^{0.5}$$

$$A = 0.0923 \text{ SQ FT}$$

$$D = 4.12 \text{ IN}$$

Select 3" orifice

Q(avg) = AVERAGE FLOW RATE THROUGH ORIFICE

H(avg) = AVERAGE HYDRAULIC HEAD

H(max) = MAXIMUM HYDRAULIC HEAD

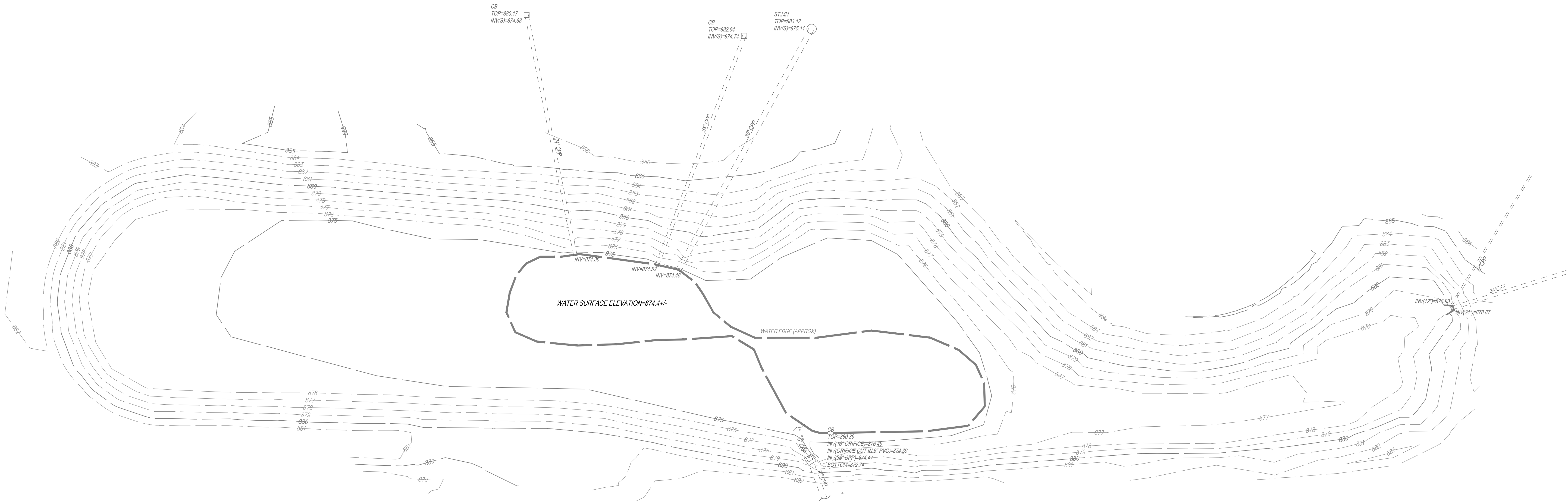
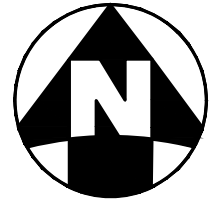
 T_d = EDv DRAIN TIME (24 TO 48 HOURS)

C = 0.6 ORIFICE COEFF.

g = 32.2 ft/sec²A = ORIFICE AREA (ft²)

D = ORIFICE DIAMETER (in) = [(4*A/3.14)^0.5] * 12

<--- Outlet Size



VICINITY MAP
N.T.S



THE KLEINGERS GROUP

CIVIL ENGINEERING
SURVEYING
LANDSCAPE
ARCHITECTURE

www.kleingers.com
6305 Centre Park Dr.
West Chester, OH 45069
513.779.7851

SEAL:



NO.	DATE	DESCRIPTION
1	12/13/13	DETENTION AS-BUILT - MDH
2	09/22/16	DETENTION AS-BUILT

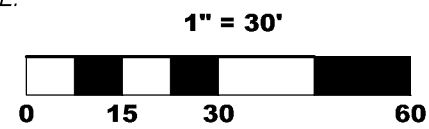
**TOPOGRAPHIC
SURVEY
DETENTION POND**

**SECTION 13, TOWN 3, RANGE 3
LIBERTY TOWNSHIP
BUTLER COUNTY, OHIO
FOR: NELSON STARK CO.**

PROJECT NO: 130037VAB006

DATE: 12/13/2013

SCALE:



SHEET NAME:

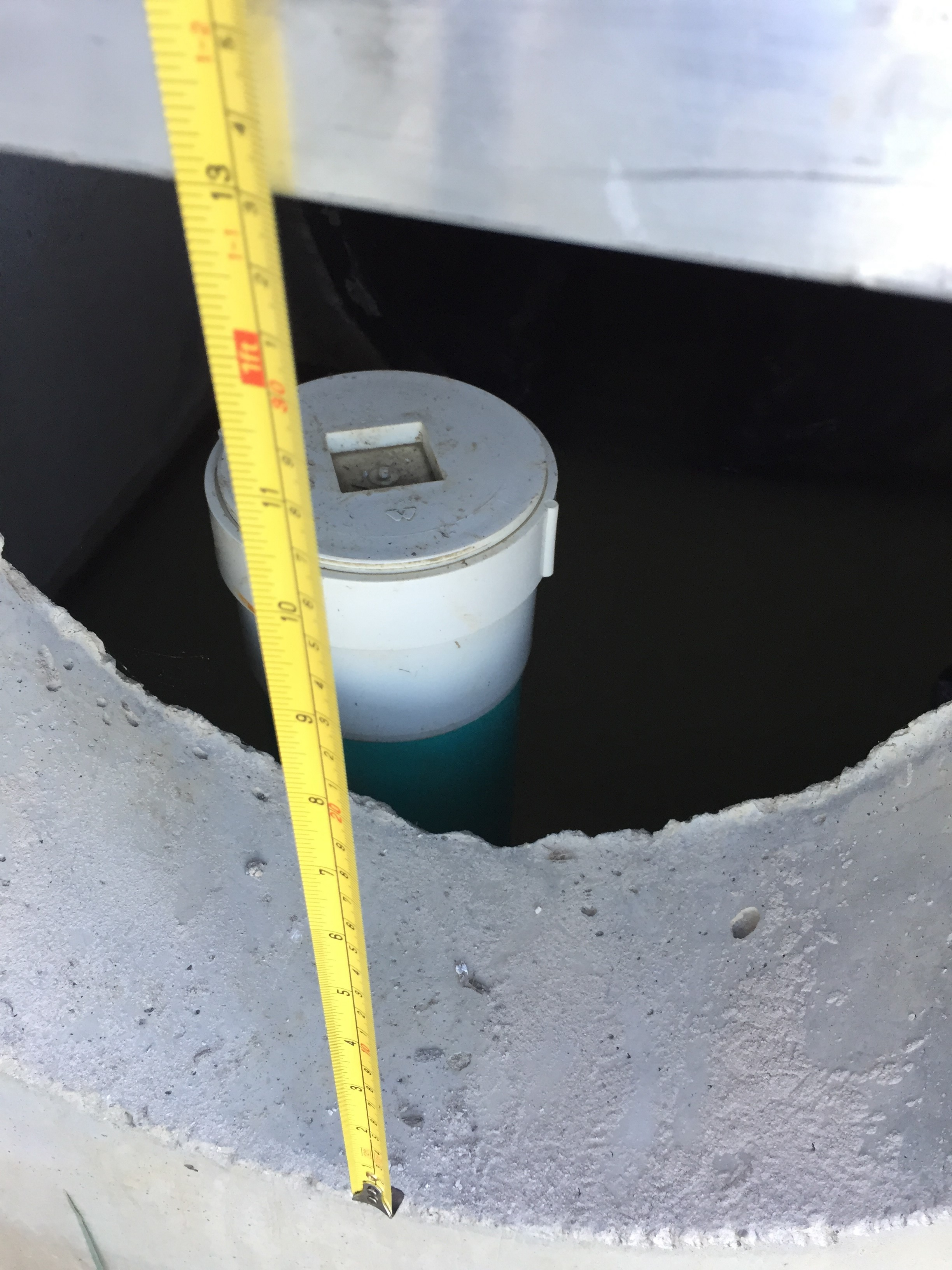
**DETENTION POND
AS-BUILT**

SHEET NO.

1 OF 1

NOTE:
UNDERGROUND UTILITIES ARE PLOTTED FROM A
COMPILATION OF AVAILABLE RECORD INFORMATION AND
SURFACE INDICATIONS OF UNDERGROUND STRUCTURES AND
MAY NOT BE INCLUSIVE. PRECISE LOCATIONS AND THE
EXISTENCE OR NON-EXISTENCE OF UNDERGROUND UTILITIES
CANNOT BE VERIFIED. PLEASE NOTIFY THE OHIO UTILITY
PROTECTION SERVICE AT 1-800-362-2764 BEFORE ANY PERIOD
OF EXCAVATION OR CONSTRUCTION ACTIVITY.









DANGER
KEEP OUT
RISING
WATER