Charles Cothern

From: Hunyadi - DNR, John
Sent: Tuesday, October 08, 2019 1:06 PM
To: Charles Cothern
Cc: Cothern, Charles; Durham, Charlene
Subject: Re: The Gardens at North Carefree Detention Pond Breech Analysis

Hi Charles,

Thank you for the memorandum and analysis. I am in agreement with your conclusions regarding the hazard classification of these structures and will look forward to the NOI forms submitted to our office when you get to that point.

Have a good afternoon.

John H.
John Hunyadi, PE
Dam Safety Engineer
T: 719.227.5294 | C: 719.258.0859
4255 Sinton Road, Colorado Springs, CO 80907
john.hunyadi@state.co.us

On Mon, Oct 7, 2019 at 4:13 PM Charles Cothern <charlescothern@springseng.com> wrote:

> John,
>
> Attached is a breech analysis for two detention ponds under design for a subdivision being processed in El Paso County.

These ponds are different from the two you helped me with at Waterview SE of the airport.

They are much smaller and they are in an area already with some development.

I believe my analysis is correct and I believe the structures would be considered Low Hazard.

If you have any questions or would like me to revise my analysis, please let me know.

Charles K. Cothern

Stantec

31 N. Tejon Street

Suite 500

Colorado Springs, CO 80903

Memorandum

Stantec
31 North Tejon Street
Suite 500
Colorado Springs, Colorado 80903
Phone: 719-227-7388
Fax: 719-227-7392

Date: October 3, 2019

To: Mr. John Hunyadi
Dam Safety Engineer
State of Colorado
4255 Sinton Road
Colorado Springs, CO 80919

From: Charles K. Cothern, P.E.

Subject: The Gardens at North Carefree Detention Pond
Embankment Hazard Classification

This memorandum has been prepared to determine the classification and the potential for breech for the detention pond embankments for The Gardens at North Carefree. There are two ponds to consider. They are identified as The Gardens at North Carefree Subdivision, North Detention Pond and The Gardens at North Carefree Subdivision, South Detention Pond. Guidelines for Hazard Classification, Office of the State Engineer, Colorado Dam Safety Branch, November 15, 2010 was used to determine the pond embankment classification. The characteristics of each pond are as follows:

North Detention Pond

The North Detention Pond is located on the west side of the property, just north of the south entrance (Vineyard Circle) to the subdivision and discharges to the existing storm sewer in Akers Drive. Ultimately storm water discharges to a tributary of Sand Creek.

Drainage Area	8 acres
Height of Water (Hw)	5.92 ft.
Storage; 100-year design storm	0.9 ac-ft.
Surface Area; 100-year design storm	0.28 acres
Crest Width of Dam	9 ft.
Height of dam to Base Elevation	7.75 ft.
Slope of Upstream dam face	3 H:V
Slope of Downstream dam face	4 H:V
Dam Size Class	Minor

South Detention Pond

The South Detention Pond is located on the west side of the property, just south of the south entrance (Vineyard Circle) to the subdivision and discharges to an existing storm sewer in Akers Drive. Discharge eventually reaches a tributary of Sand Creek.

Drainage Area	2.6 acres
Height of Water (Hw)	6.39 ft.
Storage;100-year design storm	0.42 ac-ft.
Surface Area; 100-year design storm	0.1 acres
Crest Width of Dam	7 ft.
Height of dam to Base Elevation	8.06 ft.
Slope of Upstream dam face	3 H:V
Slope of Downstream dam face	3 H:V
Dam Size Class	Minor

Classification Analysis

Both pond embankments based on proposed embankment construction dimensions are identified as Non-Jurisdictional. Following The Guidelines for Hazard Classification document previously referred to, the conclusions are as follows:

North Pond

The North Detention pond is classified as a Low Hazard Dam based on the following determinations under a failure scenario:

- No loss of Human life would be expected. The dam overflow structure if overtopped would flow into Akers Drive causing some street flooding, but would be captured by existing street curb and gutter, inlets and storm sewer. A dam breech would result in the same scenario requiring some roadway cleanup; no significant damage would be expected.
- Only minor damage, if any, would be expected to improved roads or storm sewer systems located in Akers Drive.
- Akers Drive and adjacent roadways would direct any street flooding within the roadway right-of-way to the Sand Creek Tributary which will receive the storm water discharge from the site.
- The potential for “piping” failure around the outlet structure outlet pipe is diminished because the outlet structure discharges below grade into the back of a Type R street inlet in Akers Drive; the outlet pipe does not discharge through the dam to daylight, on grade, at the base of the downstream dam face.

Based on these factors the classification is Low Hazard.

South Pond

The South Detention pond is classified as a Low Hazard Dam based on the following determinations under a failure scenario:

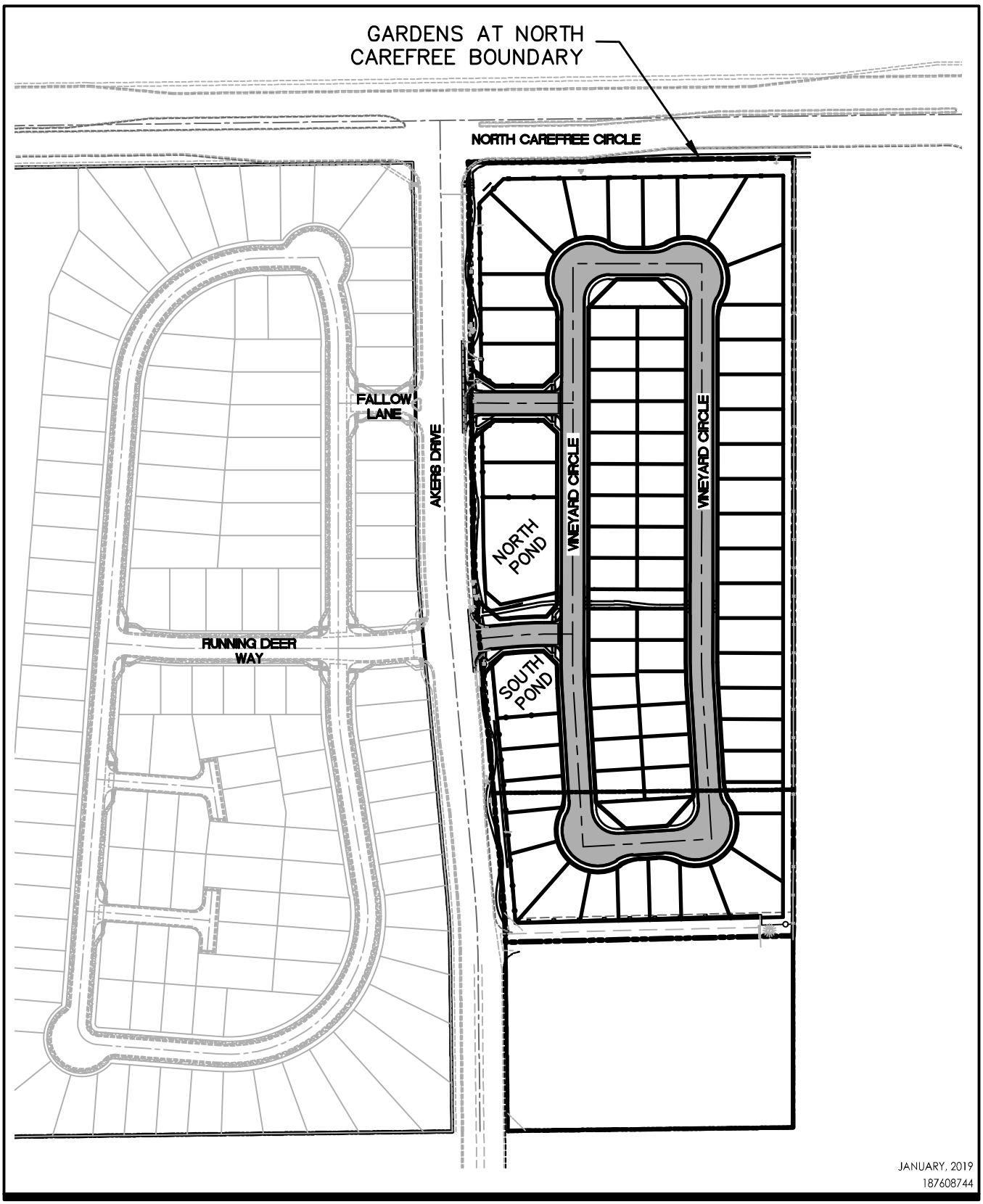
- No loss of Human life would be expected. The dam overflow structure if overtopped would flow into Akers Drive causing some street flooding, but would be captured by existing curb and gutter, street inlets and storm sewer. A dam breech would result in the same scenario requiring some roadway cleanup; no significant damage would be expected.
- Only minor damage, if any, would be expected to improved roads or storm sewer systems located in Akers Drive.
- Akers Drive and adjacent roadways would direct any street flooding within the roadway right-of-way to the Sand Creek Tributary which will receive the storm water discharge from the site.
- The potential for "piping" failure around the outlet structure outlet pipe is diminished because the outlet structure discharges below grade into the back of a Type R street inlet in Akers Drive; the outlet pipe does not discharge through the dam to daylight, on grade, at the base of the downstream dam face.
-

Based on these factors the classification is Low Hazard.

The Estimate of Dam Breech Parameters spread sheet is included for both ponds for reference. In the case of both of these structures, a "piping" failure would be unlikely because the discharge pipe does not outfall on the ground surface just downstream of the dam, but rather into the back of an existing street inlet at a depth of cover of approximately 2-ft.

Please let me know if you have any questions. If you can provide an acknowledgement of this analysis which we could use with our submittal to El Paso County, we would appreciate it.

Non-Jurisdictional Water Impoundment Structure notifications are being prepared to submit to the State per Section 37-87-125, CRS.



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Stantec

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Client/Project
MULE DEER INVESTMENTS, LLC
GARDENS AT NORTH CAREFREE

Figure No.
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Title
VICINITY MAP

ESTIMATION OF DAM BREACH PARAMETERS
USING THE MACDONALD & LANGRIDGE-MONOPOLIS OR WASHINGTON STATE METHODS
WITH ALL FAILURE TIMES ESTIMATED BY WASHINGTON STATE METHOD

PROJECT: The Gardens at North Carefree Subdivision

BREACH INPUT PARAMETERS:

Select Embankment Type From Drop-Down Menu:	EARTHEN (NON-COHESIVE)	
Height of water over base elevation of breach (H_w) =	5.9	Feet
Volume of water stored in reservoir at time of failure (V_w) =	0.9	Acre-Feet
Reservoir Surface Area at H_w (A_s) =	0.3	Acres
Crest width of dam (C) =	9.0	Feet
Height of breach from dam crest to base elevation of breach (H_b) =	7.8	Feet
Slope of upstream dam face (Z_u) =	4.0	Z(H):1(V)
Slope of downstream dam face (Z_d) =	3.0	Z(H):1(V)
Breach side-slope ratio (Z_b) =	0.1	Z(H):1(V)
Piping Orifice Coefficient (C_p) =	0.61	Used To Calculate Peak Discharge Through Piping Hole
Dam Size Class:	Minor	Assumes Full Reservoir At Time of Breach

CALCULATED BREACH CHARACTERISTICS:

Breach Formation Factor (BFF) =	5.328	
Embankment Volume Eroded (V_{er}) =	13.6	Cubic Yards
Average Dam Width (W_{avg}) =	36.1	Feet (In Direction of Flow)
Average Breach Width (B_{avg}) =	1.3	Feet
Bottom Width of Breach (B_b) =	0.5	Feet
Breach Formation Time (T_f) =	0.05	Hours
Storage Intensity (SI) =	0.2	Acre Feet/Foot
Peak Breach Discharge (Q_p) =	54	Cubic Feet per Second

RESULTS CHECK:

Average Breach Width Divided by Height of Breach (Bavg/Hb) =	0.17	If (Bavg/Hb) > 0.6, Full Breach Development is Anticipated
Erosion Rate (ER), Calculated as (Bavg/Tf) =	25.6	
Erosion Rate Divided by Height of Water Over Base of Breach (ER/Hw) =	4.3	If 1.6 < (ER/Hw) < 21, Erosion Rate is Assumed Reasonable

Reservoir Evacuation May Occur Prior to Full Breach Development - Piping Hole Characteristics calculated below.

*Piping Hole Width (D) =	2.6	Feet
Volume Eroded in Piping Hole =	14	Cubic Yards
Estimated Peak Discharge Through Pipe =	71	Cubic Feet Per Second

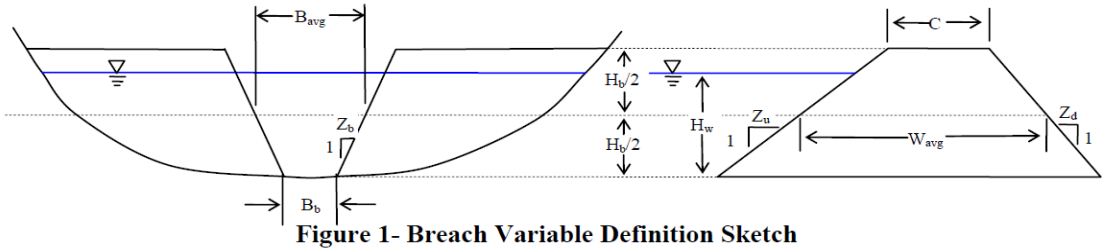

Figure 1- Breach Variable Definition Sketch

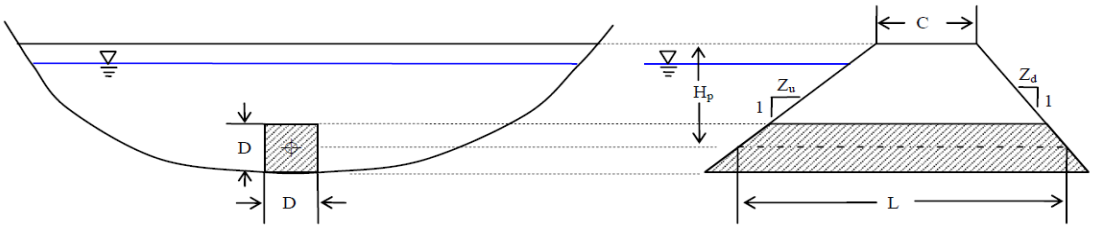

Figure 2 – Piping Hole Variable Definition Sketch

ESTIMATION OF DAM BREACH PARAMETERS
USING THE MACDONALD & LANGRIDGE-MONOPOLIS OR WASHINGTON STATE METHODS
WITH ALL FAILURE TIMES ESTIMATED BY WASHINGTON STATE METHOD

PROJECT: The Gardens at North Carefree-South Pond

BREACH INPUT PARAMETERS:

Select Embankment Type From Drop-Down Menu:	EARTHEN (NON-COHESIVE)	
Height of water over base elevation of breach (H_w) =	6.4	Feet
Volume of water stored in reservoir at time of failure (V_w) =	0.4	Acre-Feet
Reservoir Surface Area at H_w (A_s) =	0.1	Acres
Crest width of dam (C) =	7.0	Feet
Height of breach from dam crest to base elevation of breach (H_b) =	8.1	Feet
Slope of upstream dam face (Z_u) =	3.0	Z(H):1(V)
Slope of downstream dam face (Z_d) =	3.0	Z(H):1(V)
Breach side-slope ratio (Z_b) =	0.1	Z(H):1(V)
Piping Orifice Coefficient (C_p) =	0.61	Used To Calculate Peak Discharge Through Piping Hole
Dam Size Class:	Minor	Assumes Full Reservoir At Time of Breach

CALCULATED BREACH CHARACTERISTICS:

Breach Formation Factor (BFF) =	2.6838	
Embankment Volume Eroded (V_{er}) =	8.0	Cubic Yards
Average Dam Width (W_{avg}) =	31.2	Feet (In Direction of Flow)
Average Breach Width (B_{avg}) =	0.9	Feet
Bottom Width of Breach (B_b) =	0.1	Feet
Breach Formation Time (T_f) =	0.04	Hours
Storage Intensity (SI) =	0.1	Acre Feet/Foot
Peak Breach Discharge (Q_p) =	38	Cubic Feet per Second

RESULTS CHECK:

Average Breach Width Divided by Height of Breach (Bavg/Hb) =	0.11	If (Bavg/Hb) > 0.6, Full Breach Development is Anticipated
Erosion Rate (ER), Calculated as (Bavg/Tf) =	20.4	
Erosion Rate Divided by Height of Water Over Base of Breach (ER/Hw) =	3.2	If 1.6 < (ER/Hw) < 21, Erosion Rate is Assumed Reasonable

Reservoir Evacuation May Occur Prior to Full Breach Development - Piping Hole Characteristics calculated below.

*Piping Hole Width (D) =	2.1	Feet
Volume Eroded in Piping Hole =	8	Cubic Yards
Estimated Peak Discharge Through Pipe =	50	Cubic Feet Per Second

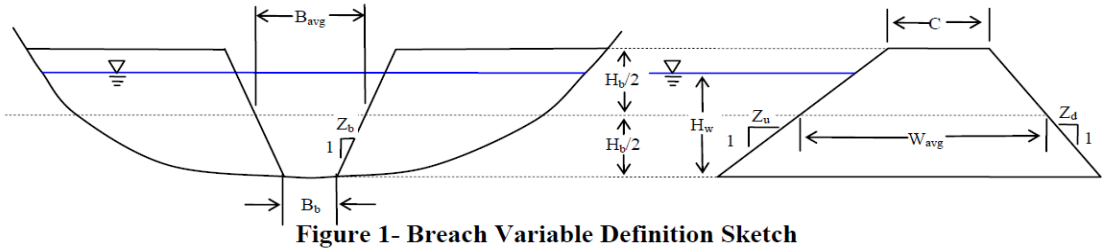

Figure 1- Breach Variable Definition Sketch

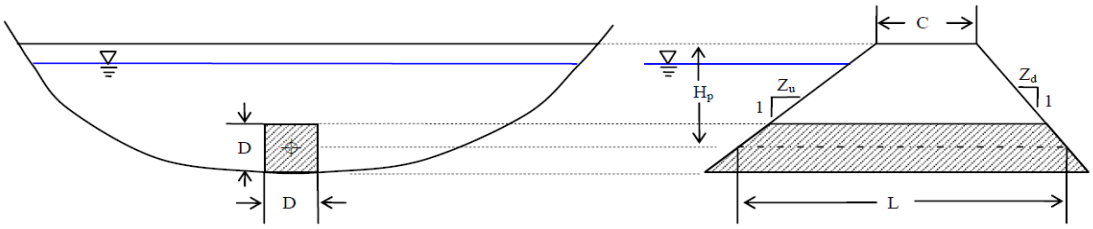

Figure 2 – Piping Hole Variable Definition Sketch