See comment letter.

PRELIMINARY DRAINAGE REPORT
FOR
TIMBERRIDGE ESTATES, PRELIMINARY PLAN
PART OF THE RETREAT AT TIMBERRIDGE
(NORTH OF ARROYA LANE)

October 2018

Prepared For:
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Prepared By:

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flows to a low point at the western side of the basin at Design Point 2, where it flows onto Basin C.

Basin C (15.36 acres) includes most of the western and northern portions of the site and is proposed for large residential lot development and the proposed Full Spectrum Extended Detention Basin. Runoff (Q_5=4.8 cfs and Q_{100}=24.7 cfs) sheet and channels flows to the detention basin in the southwest corner of the basin at Design Point 1. Outflow from the detention basin flows onto Basin E before flowing into Sand Creek.

Basin D (2.60 acres) is an area consisting of the north side of part of the existing Arroya Lane road and a small area north of the road. Runoff (Q_5=1.1 cfs and Q_{100}=4.7 cfs) sheet and channels flows to the west, where it crosses the new Nature Refuge Way road in proposed dual 24" RCP culverts and flows onto Basin E.

Basin E (1.04 acres) is an area consisting of the north side of part of the existing Arroya Lane road. Runoff (Q_5=1.8 cfs and Q_{100}=4.7 cfs) primarily channel flows to the west, where it enters Sand Creek at Design Point 5. Flows also enter Basin E from Basin D, the detention basin outfall, Basin F, and Basin OS-5 on their path to Sand Creek. Water quality for Basins E and D following the paving of Arroya Lane can be addressed by installing a sand filter in the road side swale near Design Point 5 (preliminary design calculations are included in the appendix).

Route all the developed flows to the Full spectrum detention (FSD) pond for treatment. If a sand filter is still needed install it upstream of the FSD outfall.

Basin F (0.72 acres) is an area on the western edge of the site that includes some area in large residential lot development and some area around the detention basin. Runoff (Q_5=0.2 cfs and Q_{100}=1.7 cfs) sheet flows to the southwest and onto Basin E.

Basin G (1.16 acres) is an area consisting of the north side of part of the existing Arroya Lane road. Runoff (Q_5=2.0 cfs and Q_{100}=5.1 cfs) primarily channel flows to the east, where it enters Sand Creek at Design Point 6. Water quality for Basin G following the paving of Arroya Lane can be addressed by installing a sand filter in the road side swale near Design Point 6 (preliminary design calculations are included in the appendix).

See note at bottom of calculation sheet. Freeboard is entering the culvert, not internal. Discuss size required to meet the 2-foot criteria and if a deviation might be requested at the final plat stage.

Culverts are proposed at the crossing of Sand Creek, for the detention basin outfall, at the intersection of Arroya Lane and Nature Refuge Way, and at a low point on Nature Refuge Way. Culver design calculations have been included for the proposed drainage channels.

Box Culvert Bridge at Arroya Lane Crossing Sand Creek

The three 6'x12' box culverts at the Arroya Lane crossing of Sand Creek are classified as a bridge. These culverts have been design to flow at 66.3% capacity during a 100 year storm event, which results in an internal freeboard of 2.0 feet.

Additionally the Proposed Sand filter basins proposed next to Arroya Lane will be located on private property in an easement and maintained by The Timber Ridge Metro District.

Full Spectrum

MAINTENANCE

The Extended Detention Basin and the storm drain systems are private and therefore must be maintained by the owner (TimberRidge Metro District). These should be cleaned and checked after any significant precipitation event and at least once every three months. The proposed erosion control measures will be repaired and maintained by the property owner or owner's representative as required.

Access to the Extended Detention Basin is proposed from Arroya Lane. Access to the proposed drainage easements will be from Nature Refuge Way and/or from Arroya Lane via the Extended Detention Basin.

CONSTRUCTION COST OPINION

Proposed Public Reimbursable

1. 12'x6' Box Culverts	306 LF	$ 820	$ 250,920
		Total	**$ 250,920**

Note: The Sand Creek Drainage Basin Planning Study (March 1996), calls out the removal of an existing 60" CMP and the installation of a 6'H x 12'W CBC, 10-Yr capacity at the Arroya Lane crossing of Sand Creek.

Private Non Reimbursable

1. 24" RCP	180 LF	$ 50	$ 9,000
2. EDB	1 EA	$ 20,000	$ 20,000
			Total $ 20,900

DRAINAGE FEES

The existing site is in the Sand Creek Basin. 2018 Drainage fees due prior to final plat recordation are as follows:

FEE TYPE	% IMP.	PARCEL AREA	MOD.	FEE PER IMP. AC.	SUBTOTAL
DRAINAGE FEES:	11% x	35.3 acres x	75% x	$17,197 =	$50,082
BRIDGE FEES:	11% x	35.3 acres x	100% x	$ 5,210 =	$20,230
				TOTAL	**$70,312**

SUMMARY

Development of this site will not adversely affect the surrounding development. Proposed flows, as detailed in this report, will follow the drainage patterns outlined in this report showing how runoff will be safely routed downstream. The Extended Detention Basin will control flow to historic levels and provide water quality for this site. These water features will need to be periodically maintained by the owner in order to maintain their effectiveness in cleaning the discharge form the site.

PREPARED BY:
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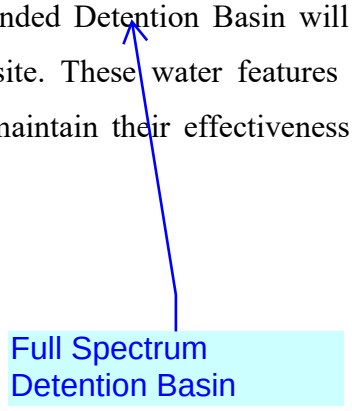

L Ducett, P.E.
President
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MANNING'S EQUATION for OPEN CHANNEL FLOW

Project: **Timber Rider Estates** Location: Point EX1 - Min 100 Yr Channel Size (Q=1.2 cfs)

By: Dane Frank Date: 5/31/2018

Chk By: Date: version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

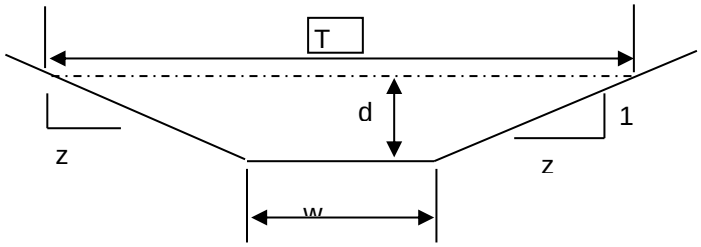
R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient



$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

INPUT	
z (sideslope)=	11.3
z (sideslope)=	17.5
b (btm width, ft)=	0
d (depth, ft)=	0.4
S (slope, ft/ft)	0.026
n_{low} =	0.15
n_{high} =	0.15

Clear Data Entry Cells

				Low N		High N			
Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Velocity, fps	Flow, cfs	Velocity, fps	Flow, cfs		
0.4	2.30	11.55	0.20	0.54535695	1.2565	0.545357	1.2565	T =	11.52
								Dm =	0.200
				Sc low =	0.5620	Sc high =	0.5620		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.3934	0.7307	0.3934	0.7307		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

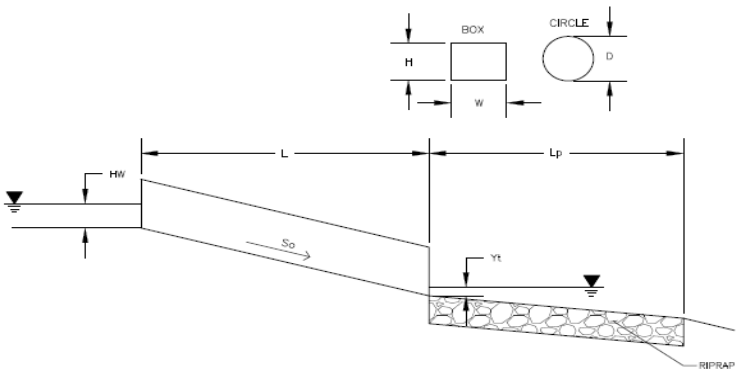
Created by: Mike O'Shea

Label the proposed easement widths, here, on each sheet, for each section EX1 through EX 11.

Determination of Culvert Headwater and Outlet Protection

Project: Timberridge Estates

Basin ID: Arroya Lane Crossing Sand Creek (2,607 cfs) - 3-6'x12' Conc Box Culverts



Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Ha to calculate protection type.

Design Information (Input):

	Design Discharge	Q =	2607	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =		inches
	Inlet Edge Type (Choose from pull-down list)			
Box Culvert:			**OR**	
	Barrel Height (Rise) in Feet	Height (Rise) =	6	ft
	Barrel Width (Span) in Feet	Width (Span) =	12	ft
	Inlet Edge Type (Choose from pull-down list)		Square Edge w/ 90-15 Deg. Headwall	
	Number of Barrels	No =	3	
	Inlet Elevation	Elev IN =	7233	ft
	Outlet Elevation **OR** Slope	Elev OUT =	7232	ft
	Culvert Length	L =	100	ft
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	Elev Y_t =		ft
	Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	2.40	ft
Flow Area at Max Channel Velocity	A_t =	173.80	ft^2
Culvert Cross Sectional Area Available	A =	72.00	ft^2
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.29	
Sum of All Losses Coefficients	k_s =	1.79	ft
Culvert Normal Depth	Y_n =	3.66	ft
Culvert Critical Depth	Y_c =	5.46	ft
Tailwater Depth for Design	d =	5.73	ft
Adjusted Diameter **OR** Adjusted Rise	H_a =	4.83	ft
Expansion Factor	1/(2*tan(Θ)) =	2.85	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/WH^1.5 =	4.93	$ft^{0.5}/s$
Froude Number	Fr =	1.83	**Supercritical!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/H =	0.50	
Inlet Control Headwater	HW_I =	10.51	ft
Outlet Control Headwater	HW_O =	8.77	
Design Headwater Elevation	**HW =**	**7,243.51**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/H =**	**1.75**	**HW/H > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	11	in
Nominal Riprap Size	d_{50} =	12	in
UDFCD Riprap Type	**Type =**	**M**	
Length of Protection	**L_p =**	**60**	**ft**
Width of Protection	**T =**	**34**	**ft**

The south report provided an analysis of 3-6x16 RCBCs. Discuss options, including what size would be required to meet the 2-foot freeboard requirement (entering the culvert).