Hydraulic Calculations

Paradise Boulevard Trail Improvements Project

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Date: 9/30/2013

Job / Task No.: PR.2009.PARTRL

Subject: Estimate the hydraulic capacity of a culvert

Purpose: Size drainage facilities to accommodate the design storm

References: City of Albuquerque Development Process Manual (1997 Revision), Chapter 22, Section 3
Hydraulic Calculations for this project area.

Assumptions:

1. Assume the inlet to the pipe is submerged and the outlet of the pipe is free.
2. Drainage system will be designed to convey existing condition flows only. Future development will be required to construct onsite drainage infrastructure that will change existing flow patterns.
3. Assume entrance to pipe is best characterized as a sharp tube with no fluid separation from the walls).
4. Assume manning's open channel flow governs flow through the sidewalk culverts.

Criteria / Requirements:

Pass flows in excess of the 10 year storm event.

Data Key:

Reference
Input
Calc
Linked

Sketches: None

Calculations:

Install Circular Pipes Under the Trail

An orifice is an submerged opening with a closed perimeter through which water flows. Orifices are analyzed using the following equation:

$$Q = CA\sqrt{2gh}$$

where:

Q = Discharge in cfs
C = Coefficient of discharge from Handbook of Hydraulics, King and Brater, 5th Edition (or comparable)
A = Area of opening in square feet
g = 32.2 ft/sec
h = Depth of water measured from the center of the opening
Approach velocity shall be disregarded in most applications.

Alternative	C	Pipe Dia. (ft)	Pipe X-Section Area (ft^2)	h (ft)	Q (ft^3)
1	0.82	0.333	**0.087266463**	0.5	**0.406059018**
1	0.82	0.500	**0.196349541**	0.5	**0.913632791**

Calculations: **Install Double Sidewalk Culvert**

Continued

Manning's Open Channel Flow

$$Q = \left(\frac{1.49}{n}\right) A R^{\frac{2}{3}} \sqrt{S}$$

Q= Flow (ft^3/sec)

n= manning's coefficient

A= Area (sq ft)

R= Hydraulic Radius (R=A/P)

S= Slope (ft/ft)

P= wetted perimeter (ft)

Alternative	n	A	P	R	S	Q (ft^3)	Q Total (Double Culvert)
1	0.013	1	4	0.25	0.02	**6.432274**	**12.86455**

Conclusions: Small diameter circular culvert pipes do not provide sufficient flow capacity. Multiple culverts would be needed to convey the required storm flows. Small diameter pipes are also not ideal for use as they will likely clog with sediment and debris.
Use of a typical COA double sidewalk culvert crossing the trail provides sufficient flow capacity to pass nearly the entire existing condition 100-year peak flow rate of 14.8 cfs. Excess flow will flow overtop the trail.