

Modeling Report
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**North Domingo Baca
Diversion Wye**

Prepared for the Albuquerque Metropolitan Arroyo Flood Control Authority



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Introduction

The Domingo Baca Arroyo is located in northeast Albuquerque. The arroyo crosses Interstate 25 just north of Paseo del Norte. Bohannon Huston is designing improvements to the arroyo which include improving several storm drain systems. In an effort to comply with NPDES permitting, contaminants from the “first flush” are being removed from some storm water systems.

Modeling Objective

The objective of this project was to build a scale model of a diversion wye and evaluate two alternatives: the first alternative consisting of the smaller pipe extending from the *side* of the larger pipe (Photo 1) and the second alternative consisting of the smaller pipe extending from the *bottom* of the larger pipe (Photo 2).

Model Design

It was desirable to use clear PVC pipe so that the water surface could be viewed at all times. Froude number similitude is required for open channel models so that the ratio of inertial and gravitational forces is the same for the model and for that which is being modeled.

Tom Escobedo, UNM Technician, and Gene Valdez, UNM Civil Engineering student, constructed the model according to the instructions given by Dr. Coonrod. The constructed model uses 6-inch PVC for the large pipe and 2-inch PVC for the small pipe. At a 1:12 scale the model would be equivalent to a 72-inch main pipe and a 24-inch diversion pipe. The purpose of this model was to determine generally the effect of the wye diversion and not to model to exact dimensions.

A concrete curb was included in the design and was built out of plywood and glued into the pipe as shown in Photo 3.

Model Performance

Photos 4-8 show the diversion wye extending to the side. In Photo 4, the flow is diverting to the side and has not yet overtopped the curb. As the flow increases (Photos 5, 6, and 7), the curb is overtopped so that storm water flows down the main culvert. Storm water also continues to flow in the smaller culvert. The amount of flow diverted was not measured. Photos 6 and 7 show a separation point in the wye. However as flow continues to increase to a higher flow (photo 8), the effect of the diversion is not seen in the main culvert (except for that the flow rate is lowered.)

Photos 9-12 show the diversion wye extending to the bottom. In Photo 9, the flow is diverting to the bottom and begins to overtop the curb. As the flow increases and continues to overtop the curb, there is a hydraulic jump (Photos 9 and 10). The water dropping into the bottom pipe is forced to drop below critical depth; thus the hydraulic jump is required to reach subcritical flow in the downstream main culvert. As flow continues to increase to a higher flow (photos 11 and 12), the effect of the diversion is not seen in the main culvert (except for that the flow rate is lowered.)

Conclusions & Recommendations

Both wye scenarios successfully divert the “first flush.” However, the potential energy with low to moderate flows in the wye extending to the bottom results in a large hydraulic jump in the center of the pipe which is not desirable. The wye extending to the side has a slight disturbance in the flow for low to moderate flows. However, this separation is much more desirable than the “rooster tail” produced by the wye diverting to the bottom. With higher flow rates the effects of the wye are drowned out.



Photo 1. Low flow diversion as designed by Bohannon Huston, Inc.

(photo taken looking down on structure, no flow)

Photo 2. Low flow diversion alternative with diversion going below rather than the side of the pipe.

(photo taken from the side, no flow)



Photo 3. Low flow diversion curb

(photo taken looking upstream into pipe)



Photo 4. Flow diverting to side.



Photo 5. Flow diverting to side and main flow overtopping curb.



Photo 6. Flow separation in side diversion.



Photo 7. Flow separation in side diversion.



Photo 8. High flow with side diversion.



Photo 9. Low flow with bottom diversion



Photo 10.
Moderate flow
with bottom
diversion

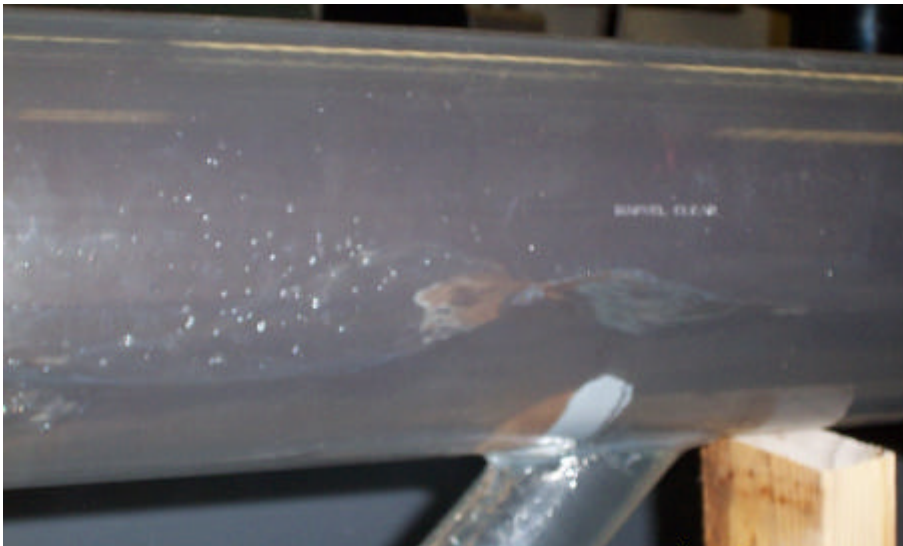


Photo 11.
Higher flow
with bottom
diversion

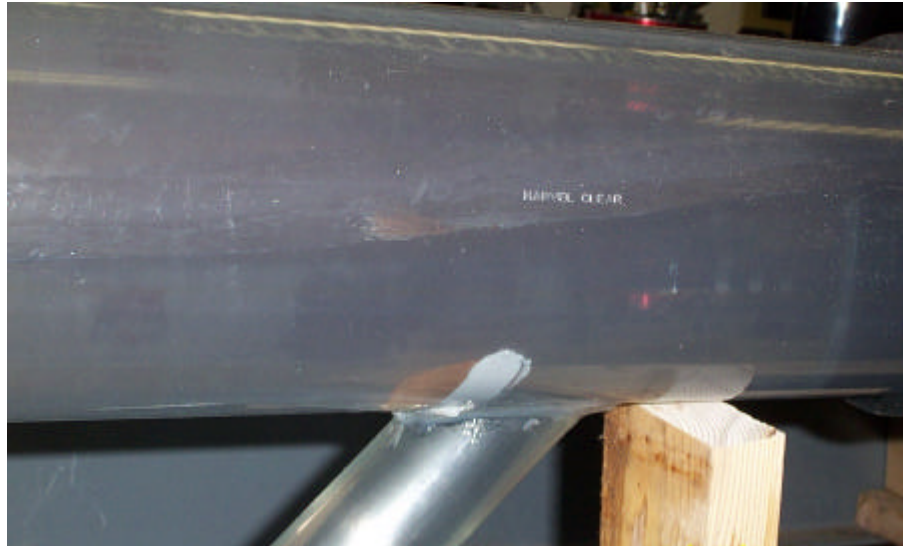


Photo 12.
High flow with
bottom
diversion