Detailed Detention Basin Analysis

Introduction

This analysis has been completed to determine the detention basin storage requirements for a specific proposed village basin to mitigate the increased flows due to development. The intent is that the results from this specific basin analysis can be extrapolated to other development areas in order to estimate planning level basin storage requirements throughout the entire Rancho Mission Viejo project.

The specific location of this analysis is an approximate 320 acre tributary to Canada Gobernadora near it's confluence with San Juan Creek. The drainage area is located west of Canada Gobernadora and encompasses 318.0 acres in the existing condition and 323.1 acres in the proposed condition.

Model Overview

10- and 100-Year expected value and 100-Year high confidence rational method analyses were completed for both the existing and proposed drainage conditions in order to develop the lag parameter for the hydrograph analyses. Single area hydrographs were also prepared for the same return events for both the existing and proposed drainage conditions, based on the lag parameter from the rational method analyses and other parameters. The proposed condition hydrographs were routed through the proposed basins in order to reduce the peak outflow to the existing condition level for all return events analyzed.

Assumptions

Since a detailed basin design has not been contemplated at this stage of the planning process, the basin has been conceptually designed. The basin is assumed to have a square bottom footprint with 3:1 side slopes on the wet side of the basin walls. A maximum hydraulic depth of 10' was assumed and the rating curves for the analysis were extended to a depth 12' to account for any freeboard requirements.

Two basin outlet types were contemplated, a notched weir and a box opening, in order to gauge sensitivity of the basin storage requirements to the outlet design.

The notched weir was designed as follows:

30" opening from basin floor up to a height of 3'
38" opening from a height of 3' to a height of 6'
46" opening from a height of 6' to a height of 9'
54" opening from a height of 9' to a height of 12'

The weir outflow was calculated using a weir coefficient of 3.0.

The box opening was assumed to have a base of 5.5' and a height of 8.0' with the invert positioned at the basin floor. The box outflow was calculated using a weir coefficient of 3.0 and an orifice coefficient of 0.6, dependent of the flow depth.

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Results

The results indicate that the box opening design is more efficient in regards to basin storage requirements and also in matching the flow characteristics of the existing condition hydrograph. This is mainly due to the basin allowing more outflow at lower depths, thus not detaining the flows as long and, therefore, not as much. The notched weir design requires approximately 19.5 ac-ft of hydraulic storage while the box opening design requires approximately 14.3 ac-ft of storage. Both detention basin outlet designs allow for the basins to drain within 24 hours of the peak, therefore, multi-day storm analysis should not be necessary.

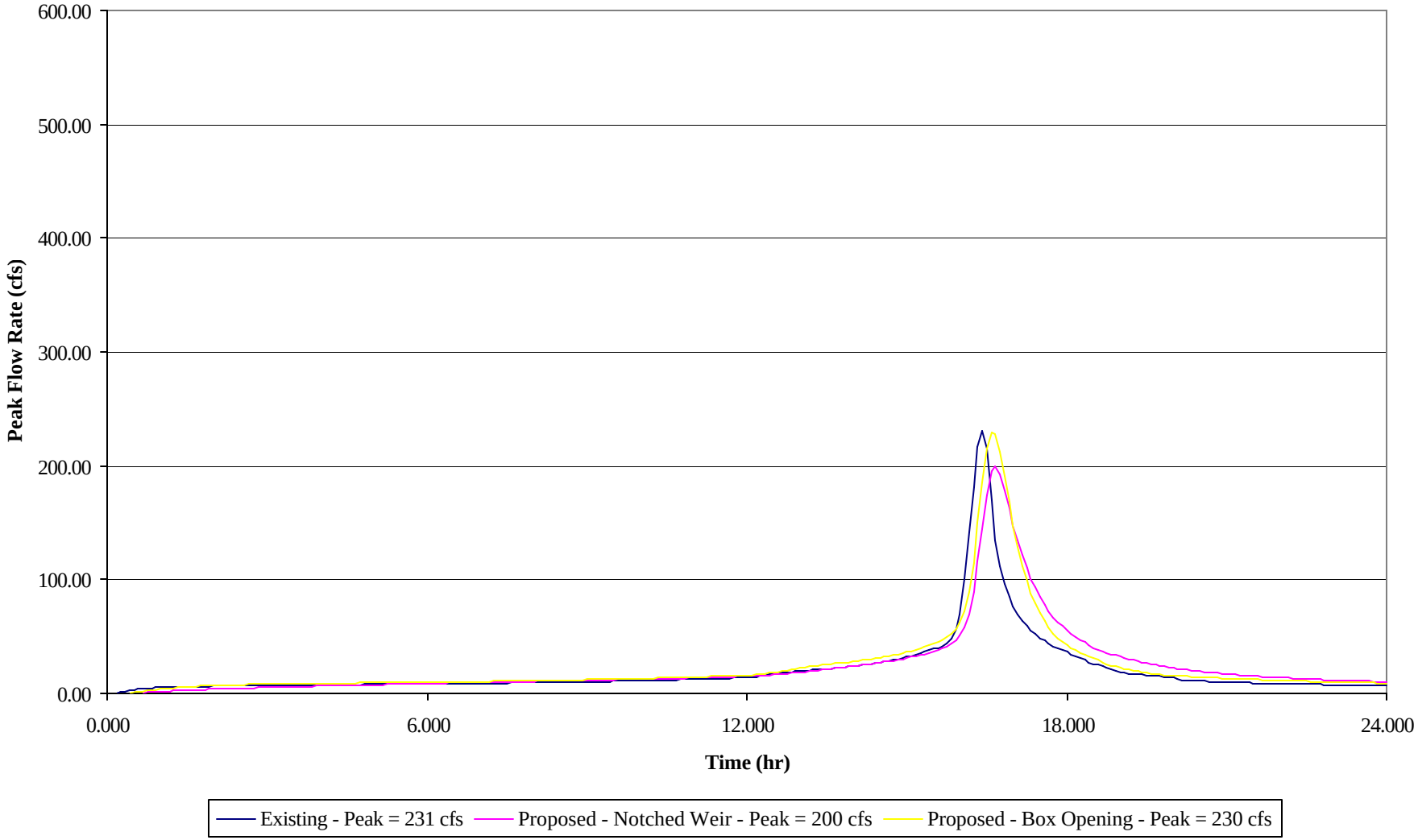
Many different basin designs are possible, outlet configuration and basin geometry will change from these conceptual planning level analyses to final design. Based on the assumptions of this analysis, these results should provide a range of probable basin storage requirements for planning purposes. However, final design of the outlet configuration and basin geometry, as well as the hydrologic analysis, may change these results.

A summary of the hydrologic analysis and graphs of the hydrographs are as follows:

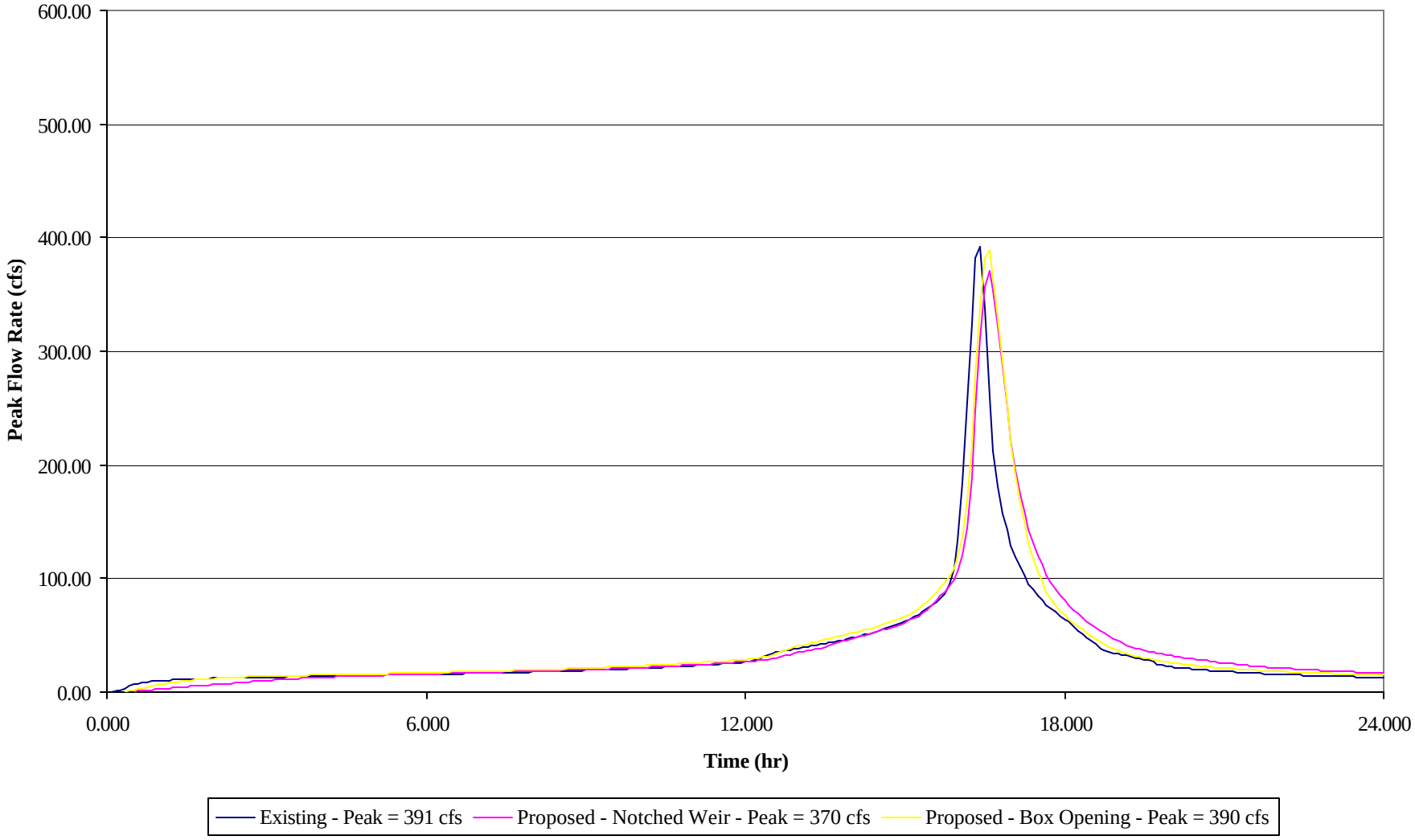
Hydrologic Summary

		Existing Condition	Proposed Condition - Notched Weir				Proposed Condition - Box Opening			
Return Event (yr)	Conf. Level (EV / HC)	Peak Flow Rate (cfs)	Peak Basin Inflow (cfs)	Maximum Basin Depth (ft)	Maximum Basin Storage (ac-ft)	Peak Basin Outflow (cfs)	Peak Basin Inflow (cfs)	Maximum Basin Depth (ft)	Maximum Basin Storage (ac-ft)	Peak Basin Outflow (cfs)
10	EV	230.7	316.4	6.6	11.9	199.7	316.4	5.8	7.6	229.8
100	EV	391.4	531.8	8.7	16.4	370.4	531.8	8.2	11.4	389.7
100	HC	521.8	700.3	10.0	19.5	512.1	700.3	9.9	14.3	508.7

Hydrologic Comparison
10-Year - Expected Value



Hydrologic Comparison
100-Year - Expected Value



Hydrologic Comparison
100-Year - High Confidence